OVEMBER 1944
CHNOLOGY DEPARTMENT

TWO SHILLINGS

Plastics

ALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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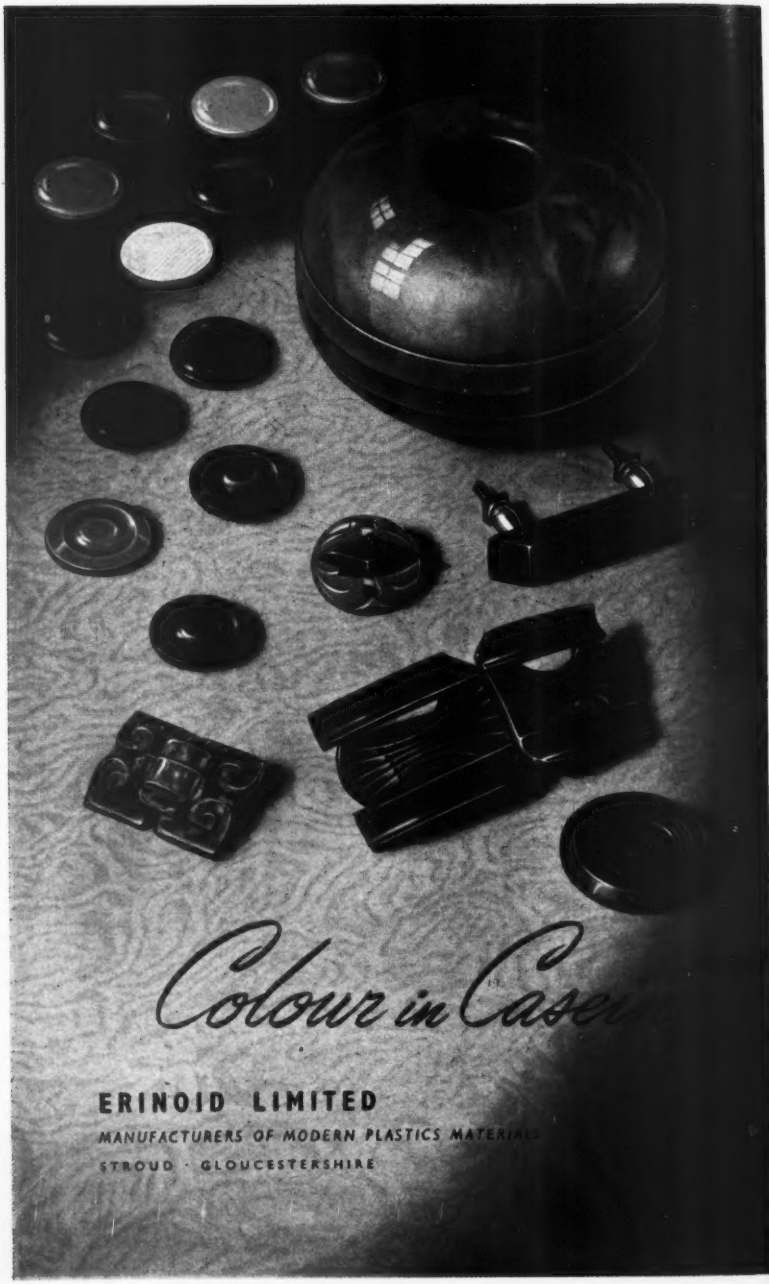
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MANUFACTURERS OF MODERN PLASTICS MATERIALS
STROUD · GLOUCESTERSHIRE

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AN INTERESTING FEATURE ABOUT *CRYSTALATE*—

is the great variety of components in Plastics which they mould for widely different Industries as is illustrated by:—

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Crystalate Ltd., Golden Green, Tonbridge, Kent. *Phone: Hadlow 233/4/5 (20 lines)*

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Both Home and Overseas Moulders know they can depend on Radyne reliability. The firm which specialises exclusively in radio heating for all industries can improve your production as well.

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H2/A	..	2½ oz/min
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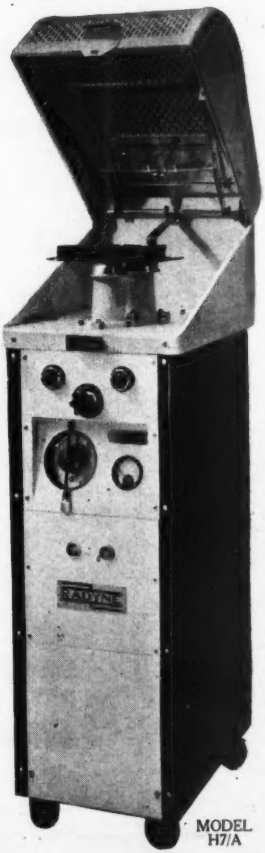

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INVITATION TO **TEST** TUBE

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Hygienic, non-toxic odourless tubes for conveying most liquids

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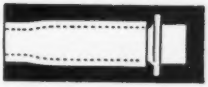
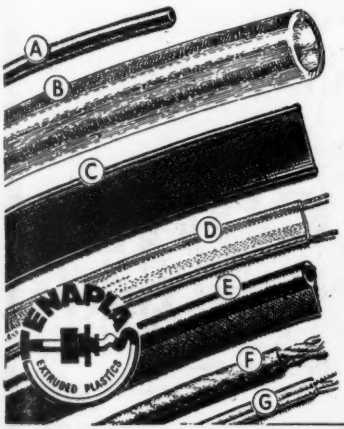
● *TENAPLAX is made in continuous extruded lengths. The only jointing is at actual connecting point. Diagram on right shows end of tubing over tight-fitting Tenaplax connector.*





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477/P.156

The Evolution of Plastics

The discovery in a Pyrenean Cave of clay figures modelled about 20,000 years ago proves that the manufacture of plastics is one of the oldest crafts.

Whereas the ancients were restricted to clay for making ornaments and utensils, Science has placed at the disposal of the 20th-century manufacturer a variety of plastics suitable for use in many industries.

At Stamford Bridge, York, Derwent Plastics, Ltd., have an up-to-date plant and a perfect organisation for the manufacture of moulded products used in the car, electrical, radio, optical and other trades.

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E.I.H.

What in **plastics** *is it!*

Up there, in the sky ... something new! Is it a flying what's-it or a mere 250-seater off on the Pacific run? Who knows? Who knows, for sure, just what will be possible with the aid of plastics? In many industries they are already established as indispensable materials, and the research into their potentialities goes on. In the technical departments at BRP, for instance, the possibilities of new materials which will lead to new manufacturing processes are continuously being investigated. Production engineers who have to keep in touch with the latest developments in plastics keep in touch with BRP.

Ask **BRP** *about plastics*

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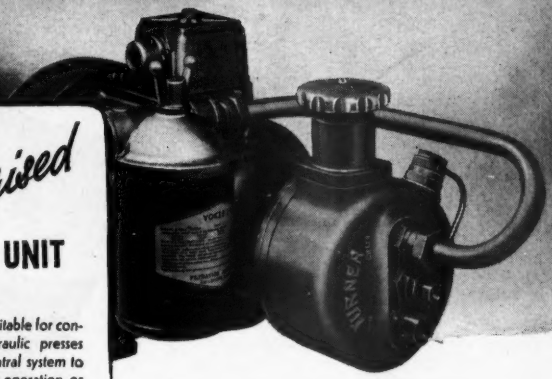
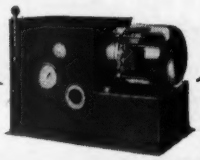


THE *Motorised* PUMP UNIT

This Unit is suitable for converting hydraulic presses from the central system to independent operation, or may be used for operating a range of small hydraulic presses. It is a completely self-contained hydraulic system in which is mounted the Turner A.V.D. Pump directly coupled to a totally enclosed surface-cooled electric motor running at 1,500 r.p.m. Full details sent on request.



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Turner Automatic Variable Delivery Pumps have been designed for compression and injection moulding machines, and for other applications requiring simple and reliable control of variation in volume and pressure. The idling pressure of the model illustrated above is easily adjusted from 500 p.s.i. to 2,500 p.s.i. and once the predetermined maximum is reached the pump automatically moves to a no-stroke position, maintaining the pressure without relief valve, cut-out valve or accumulator. Three types of Turner Hydraulic Pumps are available :—Automatic Variable Delivery, Variable Delivery and Fixed Delivery. Literature describing the complete range will gladly be sent on request.

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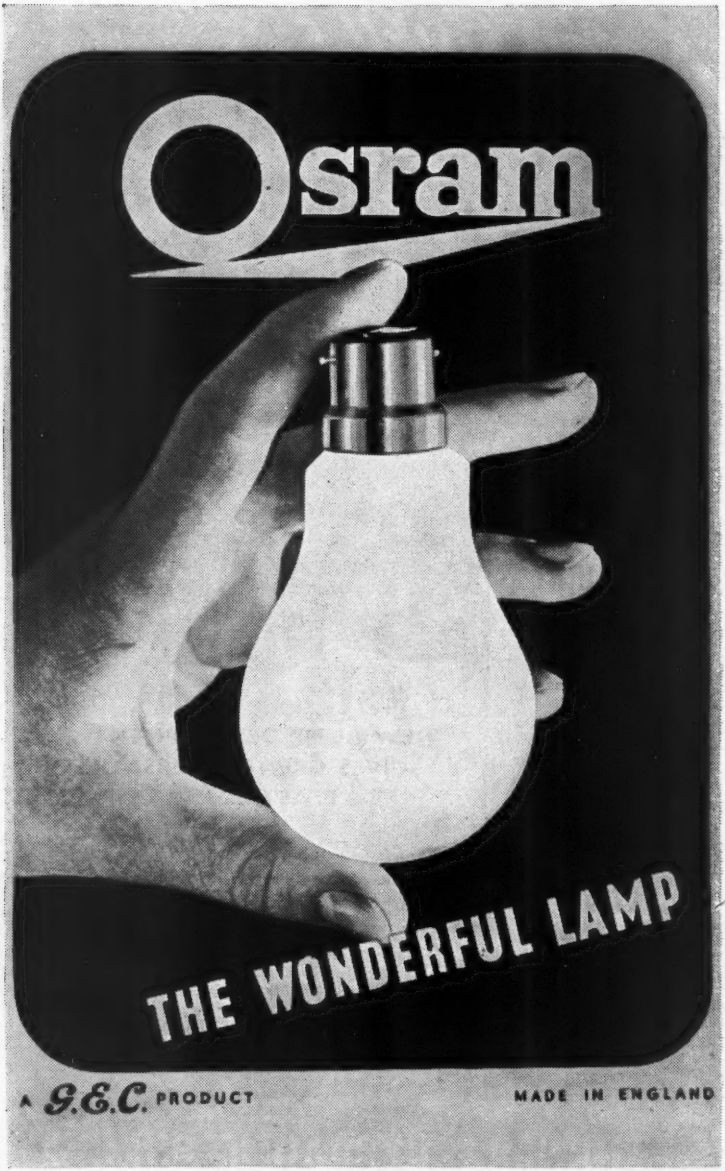

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PERMALI is a fully impregnated, densified, laminated wood. It is available in the form of flat or curved sheets, rods or machined parts. Of great value as an electrical insulating material where mechanical strength is required, Permali is also widely used for general engineering purposes where a high strength-weight ratio, machinability, or resistance to weathering and corrosion are important.

Machinability

Permali may be sawn, planed, turned, drilled and tapped on standard machine-tools.

Dimensional Stability

Permali is highly resistant to moisture, oil, mild acids and alkalis, and remains dimensionally stable under normal working conditions.

Electrical Strength

The combination of great mechanical and electrical strength offers many advantages to the designer of insulating components which are subject to heavy mechanical stress.

High Strength-Weight Ratio

Half the weight of aluminium, with a tensile strength of 12 tons p.s.i., Permali is an ideal material where strength and lightness are both essential.

Resistance to Heat

Permali remains unaffected by exposure to temperatures up to 100°C.

PROPERTIES OF PERMALI

Electrical Strength = 100 volts/mil.

Impact Strength = 5.5 ft.-lb.

Tensile Strength = 28,000 p.s.i.

Compressive Strength = 30,000 p.s.i.

Specific Gravity = 1.28 — 1.32

FREE DATA BOOK

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A wartime " must " has become a peacetime demand. " Holoplast " is specified by leading architects and designers for partitions, ceilings, doors and furniture.
" Holoplast " laminated structural plastic is available in standard panels 8 ft. x 4 ft. x 1 in. overall, in natural brown, cream-sprayed, or with veneered surface.

Its easy manipulation and speed of erection save many man-hours.
It is vermin-proof and hygienic.
It is resistant to oils and dilute acids.
It can be cut, sawn, drilled, routed, planed, etc., by normal joinery tools.
It is fire-retarding — it neither supports combustion nor spreads flame.

Full information about this outstanding material is obtainable from the manufacturers or the distributors.

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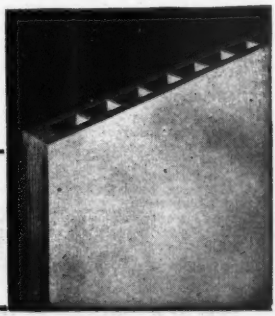

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C.M.15

Hycar Synthetic Rubber is SUPER oil-resistant

The oil seals shown here were manufactured from Hycar synthetic rubber for use under stringent conditions of service. In every case Hycar was chosen for the job because long life and complete dependability were required. Leading manufacturers regard Hycar as the essential material for oil seals because Hycar *combines* these outstanding characteristics: it is unaffected by mineral oils and grease, it remains dimensionally stable under extremes of temperature and pressure, and it stays resilient under all conditions, ensuring a perfect seal at all times. Full information is available on request.

Note these Hycar features

50% greater abrasion resistance than natural rubber ● 15 to 25% lighter than many other synthetics ● Compounded in a wide hardness range from extreme soft to bone hard ● Will not adhere to metal even after prolonged contact under pressure — but adhesion can be effected when desired.

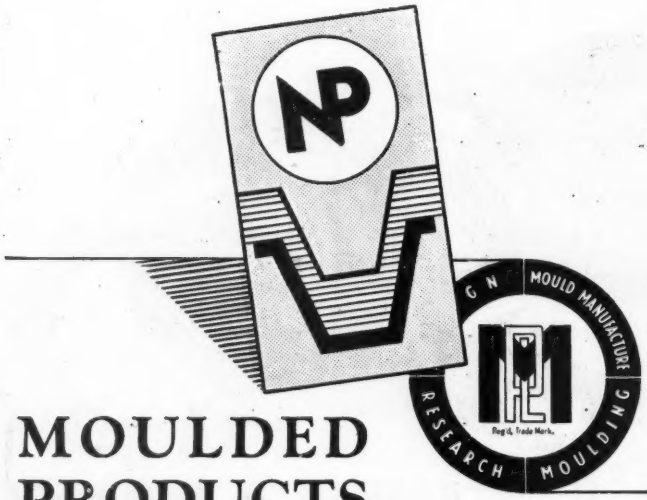
Specify Hycar for outstanding performance!

Illustration by courtesy of Messrs. George Angus & Co. Ltd

Hycar Synthetic Rubber

British Geon Limited

Sales Office: Abbey House, Baker Street, London, N.W.1. Telephone: WELbeck 2332/6.



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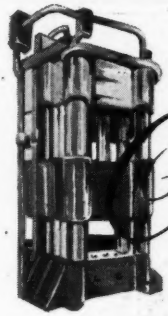

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1,500-ton Fielding & Platt Downstroke Hydraulic Press, table 5′ square, daylight 5′, with self-contained Pumping Equipment.

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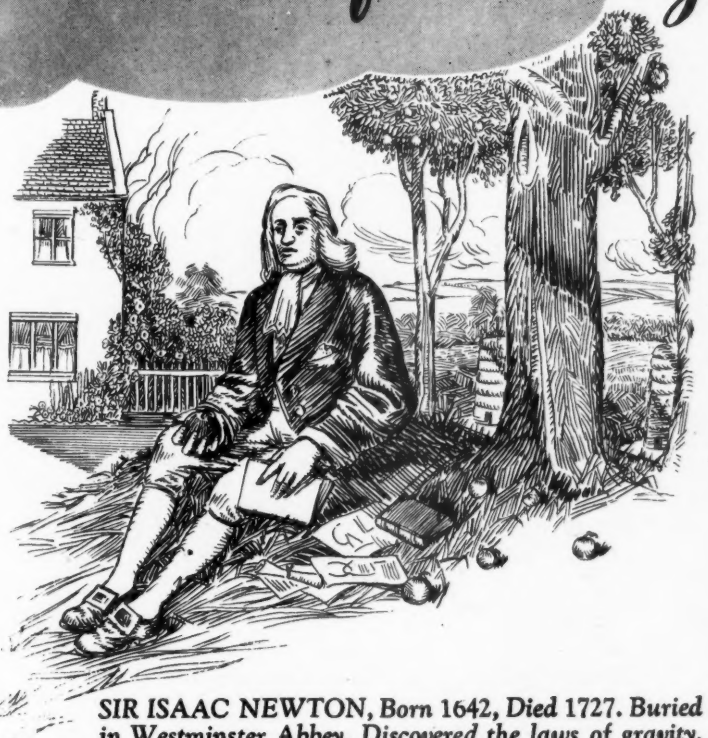

SIR ISAAC NEWTON, Born 1642, Died 1727. Buried in Westminster Abbey. Discovered the laws of gravity, among other great achievements, and his name will always be honoured in the world of Physics. A Pioneer in thought and practice.

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SO WATT. It was James Watt, y'know, who dragged horses into this business of measuring power. In a kind but firm way he persuaded a large shire horse to raise a weight of 550 pounds to a height of one foot in one second. After some discussion the horse and Watt agreed to call this One Unit of horsepower though some claim that the horse wasn't trying. Many years later we entered the racket and before long had a whole team of tiny horses working in various small tools with quite astonishing efficiency. Watt's old horse would have felt pretty sick if he'd been asked to revolve at 2,500 revs. per min. Desoutter-trained horses are doing it all the time. And never get the staggers.

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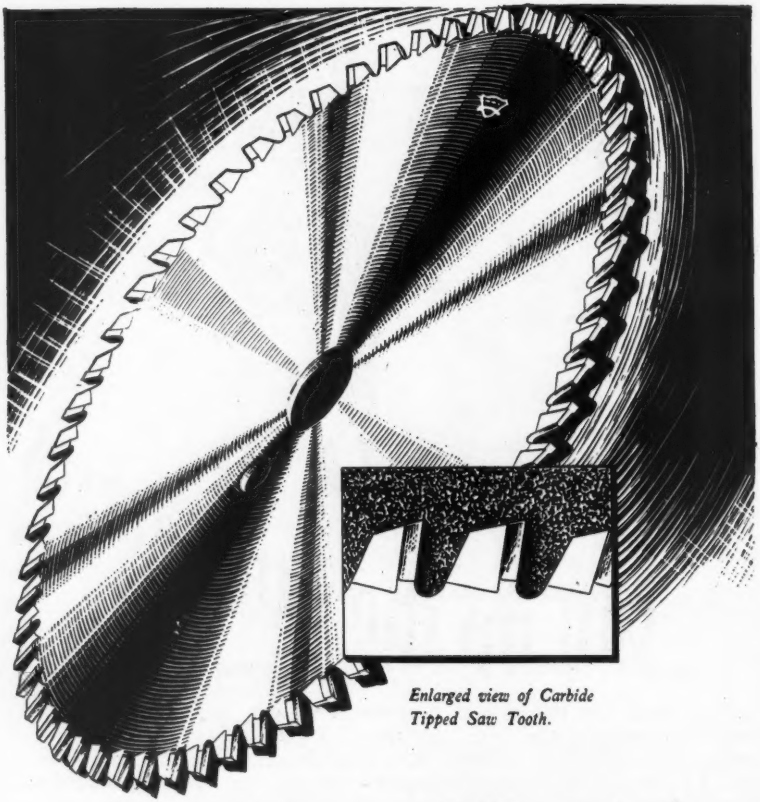

Enlarged view of Carbide Tipped Saw Tooth.

Abrasion abdicates

The cutting of plastic and plastic bonded materials causes rapid blunting of cutting edges and calls for large stocks of tools. Sagar carbide tipped saws, knives and solid cutters banish the abrasion bogey, last longer between sharpenings, cut more quickly with a fine finish and waste less material. Plastic sheeting is kept safe from shattering and the keen cutting maintains the necessary coolness in thermo-plastics. We shall be glad to demonstrate how Sagar Carbide Tipped Tools can speed production and cut costs.

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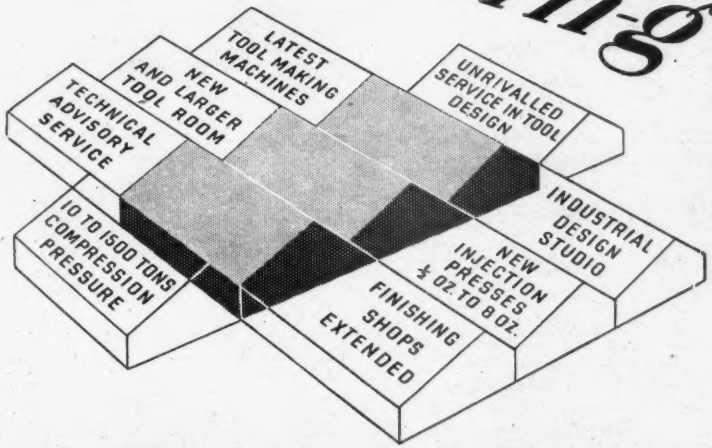
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Ekco Plastics manufacturing capacity has been greatly increased by new plant, by factory extensions and by the return from war service of many expert technicians. If you have a problem in plastics, remember that Ekco has the 'know-how' to resolve it.

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We have extended our finishing shops and laid down new plant, ranging from 10 to 1500 tons compression pressure, including a 750-ton British-made press.

Thermoplastic

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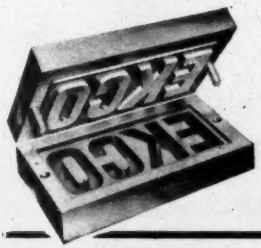

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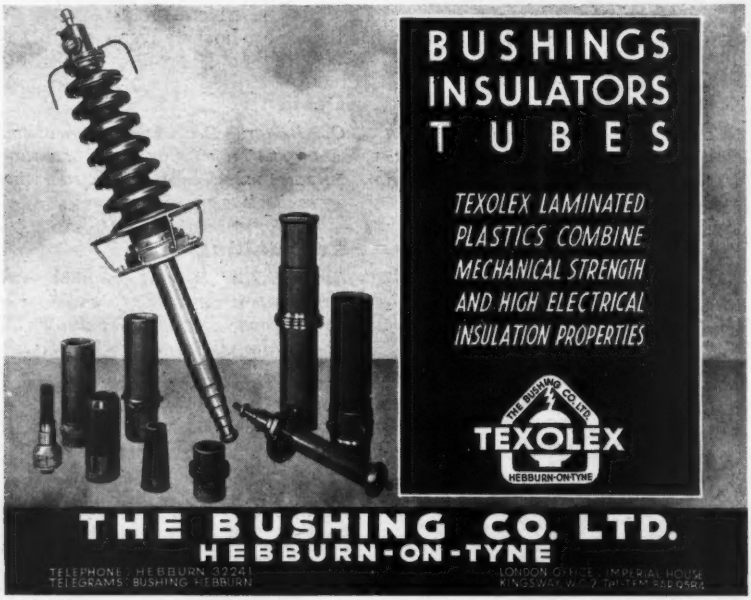
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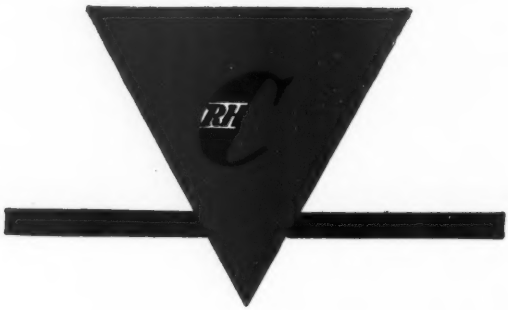

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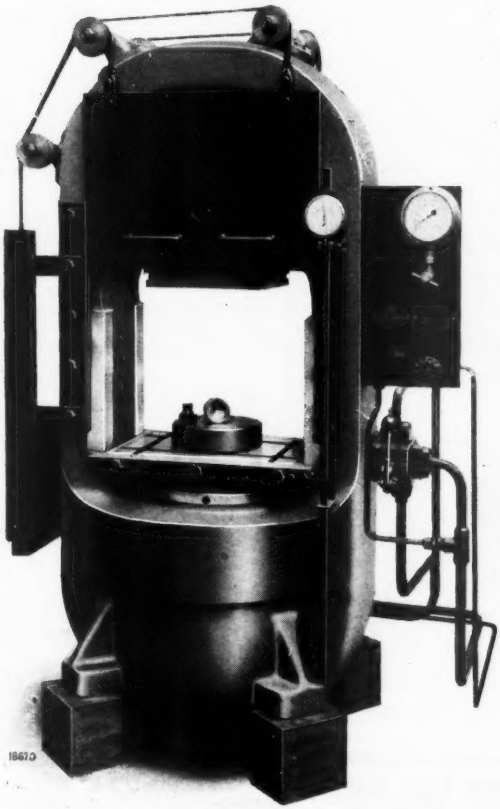

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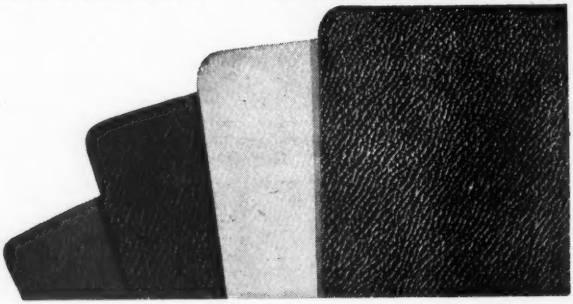

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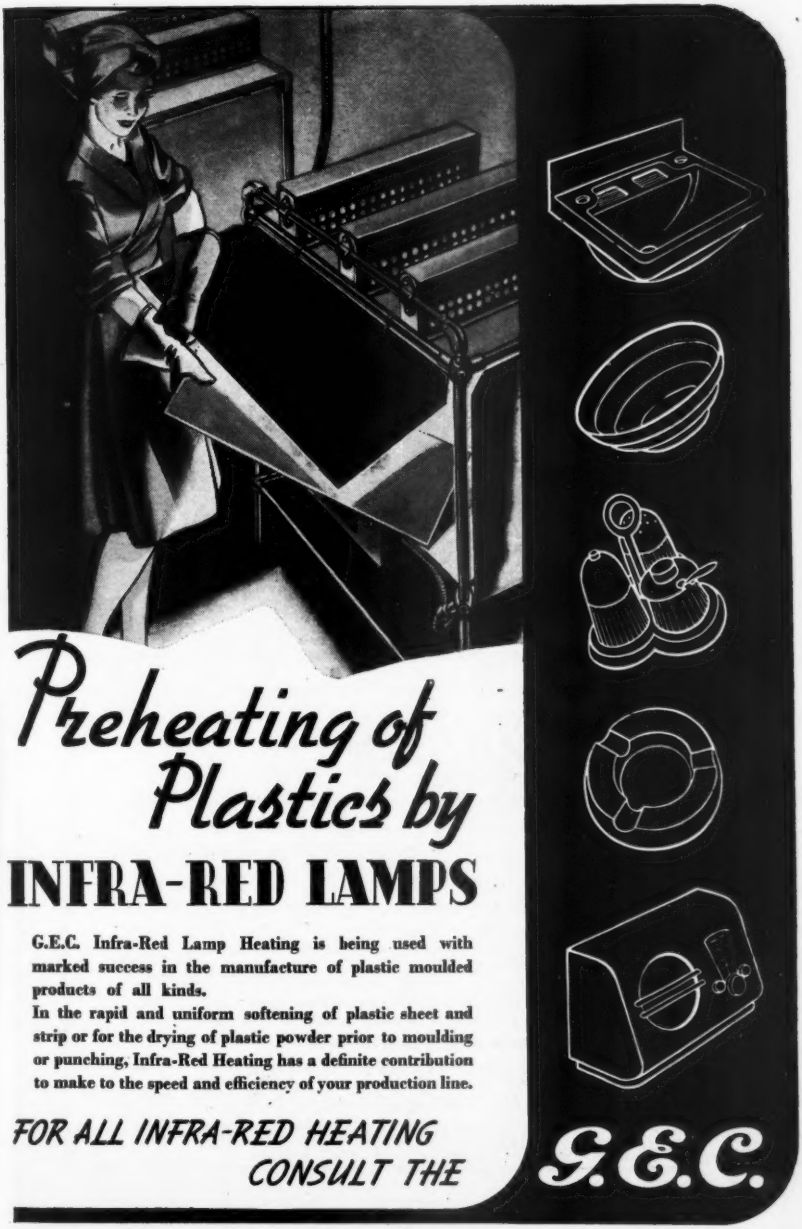
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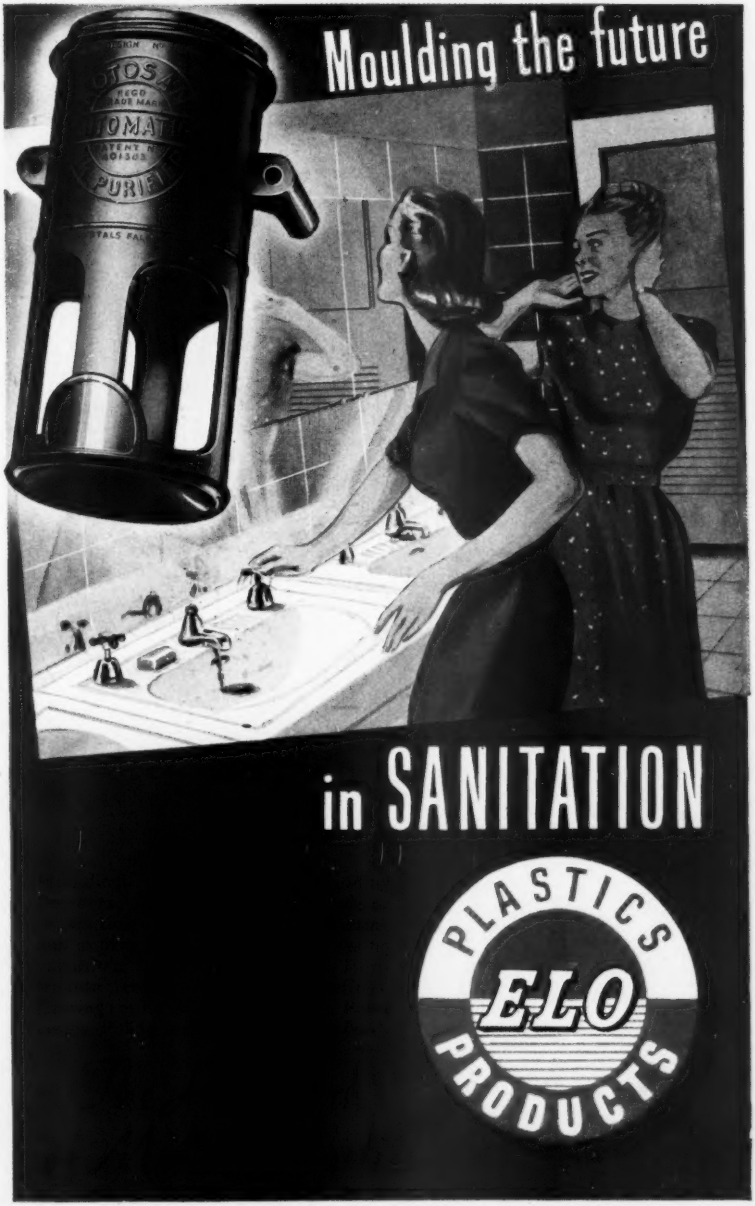

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Vol. XI. No. 126 NOVEMBER, 1947

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Managing Director - ROLAND E. DANGERFIELD

Editor - - M. D. CURWEN, B.Sc., A.R.I.C.
Offices - Bowling Green Lane, London, E.C.1

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NOTICES

"PLASTICS" is published in London, England, on the second Wednesday of the month.
Annual subscription rate, 26/-. Shorter periods, pro rata.

All instructions, matter and passed proofs of all kinds of advertisements must reach the Head Office of "PLASTICS" by the 24th of preceding month to ensure insertion.

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EDITORIALS

Design and Purpose

ELSEWHERE in this issue we publish, with permission of the editor of "Kunststoffe,"* an article that has appeared therein under the title of "New Plastic Tableware." It will be, we are sure, of great interest to most of our readers, especially those who are aware of the versatility of the moulding technique, of the close tolerances which may be reached and of the enhanced possibilities of exact repetition of our processes compared with those of certain conventional methods and raw materials. It is by such understanding that we may, if we will, cut new paths of industrial endeavour.

The value of saving weight by the use of plastics where such saving is necessary and apposite to design, safety or other considerations, has been discussed since plastics first appeared on the scene, and it is interesting to read the author's statement that a ship may possess 10,000 china cups of a weight of 3 tons, while a similar number of plastic ones weigh under 7 cwt. The plastic ones are thinner than the china.

This is, of course, important, but what must be sometimes more important is the fact that by using plastics instead of chinaware and because of the exactness of repetition obtained by the moulding process we can save a great deal of space, and the better the design the more space we save.

The advantage is especially noteworthy so far as cups are concerned, for it is certainly a truth that the conventional china cup cannot be stacked or nested at all with any degree of safety. That this is so, is due to two factors. The first is that because of the high temperatures necessary in manufacture, exact repetition of sizes and shapes is impossible. The second is the closed cup-handle, which, again because of the high temperatures and flow of thin or certain forms, cannot be made open. It is, therefore, axiomatic that to attain highly efficient stacking or nesting we must have either no handle at all, or an open one.

The idea is obviously not a new one to this country, but it is the first time, we believe, that this problem of design has been set down in print with such precision and thoroughness. From this point alone the writer is to be congratulated for the matter is of importance and worthy of similar serious consideration here by moulders and designers who may be called upon to examine specialized tableware for ships, milk bars and canteens where space is all-important and breakages even more so.

While the general form of the cup itself must be carefully designed (the author's example is extraordinarily so), it is obvious that the form of the handle is the more responsible for space saving and deserves further comment. He has opened it up, completely sweeping away from the main body. It is difficult to criticize this from a drawing and we presume the finished job is a success, but we wonder if this has not been done so violently as to sacrifice function for ease of moulding which, in our opinion, the author stresses too much.

It must be remembered that the conventional china cup handle has been evolved through the years and its present shape must be regarded as exceptionally suitable and functional. Its only fault so far as the present problem is concerned lies in the half-inch where its base joins

* We are glad to announce that this excellent journal has now resumed publication under the editorship of Dr. Escales, who has returned after a long and painful imprisonment in a concentration camp. His work and the valuable and carefully compiled scientific notes and articles in "Kunststoffe" have been admired throughout the world. The journal is now published by Carl Hanser, of Munich.

the cup. There is no basic reason why the general shape should not be retained so long as there is a hiatus at this point. Nesting can then take place by "staggering" the cups circumferentially, the number possible of nesting being the circumference of the rim divided by the thickness of the handle.

We believe the author's design of it more "artistic" so far as we can judge, but we fear that his handle would need an unfamiliar grip between fingers and thumb with less effective pressure, resulting in unbalance and strain rendered greater by the shifted centre of gravity, especially when the cup is full.

This is no serious criticism of the work—even if the criticism is sound, there are obvious remedies. We merely stress this point because on the whole there is a tendency for the search for ease of moulding to be over-emphasized.

We shall watch progress in this type of development with interest, and again express our thanks to the Editor of "Kunststoffe" for his kind collaboration.

The Search for Novelty

MAN has demanded something new since the dawn of time, but there is little doubt that modern man of the 20th century demands it (or perhaps has it forced upon him) at a pace which is completely bewildering, nauseating or delightful, according to individual opinion.

In the old days, by which we mean about 30 or 40 years ago, novelty and novelties (sharply distinguished from invention and useful things in general) referred to objects of small size—odd objects which were pretty or amusing or of some such attribute, but which ended their existence, after a month or so's use, in the back of a drawer or—the dustbin.

In other words, "novelty" is generally a misnomer of wide application, covering anything from ladies' dress decorations to cigarette lighters disguised as toy elephants, and from umbrella handles to "trick" knives and forks made of rubber; they may be well or badly designed, useful or useless, the guiding principle being that the public is always attracted to a new shape, new colour or new "idea."

Such things have their "value," even when they are often useless, but where the "novelty" is applied to larger objects of general utility merely for the sake of increasing sales by introducing a new shape to attract attention, but possessing no fundamental improvement in function, then such production has no true place in our economic or industrial system. It is a waste of the machinery and labour employed and expended in the manufacture. Such types are often the work of "designers" who are in fact little more than nimbly mechanically minded, or draughtsmen urged on by principals who see money in novelty per se. It is to be hoped that our present difficulties, the move to cut out unnecessary products in production and improvements in standardization will gradually eliminate the unnecessarily useless without killing human ingenuity.

We earnestly wish that organized industry had controlled itself in the past in this respect. We shall one day be hanged high on Tyburn tree for our heresies (although we are not always averse to life's useless objects). Yet we should like to say that we cannot conceive, for example, why the wonderful invention of carrying sound through the air without wires or other intervening methods of conveyance should be translated at the point of reception into fake Sheraton sideboards, miniature Greek temples, or into something resembling a Chubb's burglar-proof safe, none of which accords with 99 per cent. of modern houses or flats. Is not all this a deep-laid plot by scheming rádio manufacturers and their companions in crime, the cabinet makers.

At least those manufacturers who employ plastic cabinets sometimes effect a welcome change and produce something that does not merely add to the furniture. When it is realized that sound should be heard and not seen, plastics will probably supersede the costly exotic woods we see so wastefully, and we believe

wrongly employed to our æsthetic and economic detriment.

Perhaps our master thinkers will conceive new methods of dealing with television and any other inventions that may come along, by incorporation in the very housing structure, otherwise our future living-rooms will resemble the bowels of " ye antique shoppe."

Streamlining

PURSUING our seemingly unending way on this and allied subjects, among such novelties in the past few years we observe the extraordinary craze for streamlining which has entered so many spheres of production—quite irrespective of its purpose and value. Streamlined aeroplanes, ships, railway engines and sports motorcars, yes; but streamlined furniture, refrigerator-boxes, radio cabinets, and like static things—surely no. Even with the dynamic we can get the inappropriate. Is there anything more ridiculous than the super-streamlined, pastel-painted delivery van hurtling through the traffic of London at the colossal speed of 12 miles per hour?

There is, or was, of course, a very good reason for the smooth rounded corners seen in most mouldings, for resin powders do not flow like water and sharp corners and edges are treacherous points. But, even so, many designers exaggerate the necessity for care and plunge into voluptuous curves without rhyme or reason except that of following the general craze. This is to be deplored, not only because it is often poor design, but also because with modern methods of pre-heating resinous compounds the careful moulder, with good mould design, can produce excellent results with a freedom he would not have attempted five years ago. The moulder is in touch with technical developments more than is generally understood by outside industry.

In this connection it is interesting to read the advice of Mr. N. E. Kearley, Deputy Director of The Council of Industrial Design, who in a recent article in the " Observer " entitled, " Streamline Nonsense," regards as a retrograde step the use of curved surfaces if the only reason for using them is because it is so easy. " Designers," he concluded, " should consider all factors before letting the apparent ease of producing curved surfaces lead them into the jungle of the pseudo-streamline. Streamline where there is a stream of air or water, by all means; but otherwise let's give the word —and the idea—a rest."

Domestic Water Pipes

IN our October issue we mentioned that plasticized polyvinyl chloride is a suitable replacement for lead for the home and for the works, resulting, moreover, in an " unburstable " pipe in freezing weather. It is certainly true that p.v.c. pipes have been so used and also as condenser piping in chemical works and for the conveying of special fluids such as beer.

There is little doubt, however, that such piping will preferably be made now in polythene. Plasticized p.v.c. suffers from the defect of containing plasticizers which slowly evaporate in part, thus affecting the hardness of the material.

On the other hand polythene, tough, resilient, with its curious quality of expanding under pressure and retracting to its original form on release of that pressure, completely resistant to water and almost every other compound which might affect it, and above all containing no plasticizers which might change it adversely on volatilization, approaches the ideal more closely.

Industrial Research

The Federation of British Industries has published a report on scientific and technical research in British industry in the factories themselves.

The total annual expenditure is of the order of £30,000,000, which represents some 0.6 per cent. of the total value; this figure has been estimated from actual figures obtained from 420 firms spending £21,815,000.

The chemical industry employs, as it always has done, more scientists than any other group under examination, the 65 chemical concerns (15 per cent. of the industry) employing 2,340 qualified employees.

Various types of nylon cordage.
(Courtesy of British Ropes, Ltd.)

Nylon Ropes Find New Uses

By John D. Glenn

DURING the war years nylon ropes were extensively used for towing gliders; to-day similar types of cordage are finding new and interesting applications in industry, and on board ship.

One of the most important uses for nylon ropes is found in spinning mills, where they are utilized for spinner draft ropes, drawing ropes and rim bands. Exhaustive field tests carried out over many months have shown these new ropes to give greatly improved performance and efficiency. In particular, the use of nylon ropes in textile mills reduces re-roping stops and machine breakages, which normally require the expenditure of costly man-hours and the disruption of working schedules. In comparison with ropes made of natural fibres, the nylon ropes have a higher tensile strength, greater elasticity and therefore firmer frictional hold, and longer life. Of importance is the fact that nylon ropes are impervious to moisture and mildew, whereas cordage made of natural fibres is liable to deterioriate in strength when used under damp conditions. Mill managements claim that with nylon ropes it is easy to determine the degree of wear at a glance; moreover, these ropes do not dry out and shrink in use or storage.

Nylon yacht ropes, anchor lines, mooring lines, etc., compete with manila and linen ropes for use on sail and motor craft. The outstanding advantages of the new synthetic cordage are somewhat numerous. They resist rot, marine decay and teredos (ship worms), and their high tensile strength enables smaller required sizes to be used. These take up less storage space and have a lower rope weight, or, if desired, give a longer rope line for a given weight. The great elasticity of a nylon rope is a most valuable feature as in an anchor line it ensures easier riding, gives a greater degree of

safety and permits a shorter line in crowded anchorages. Sailors and yachtsmen appreciate the smooth, easy handling of nylon ropes, wet or dry, and the fact that they do not get stiff or hard or jam in blocks. The long life and attractive silvery appearance of natural or undyed nylon ropes are also worthy of comment. Their good looks are retained indefinitely, as nylon is easy to clean, and is not injured by repeated washing with soap and water.

Although nylon ropes are more expensive than ropes made of natural fibres, they can claim to be generally superior to the latter in mechanical strength, durability and appearance. A number of industries are now examining the claims of nylon as a cordage material and carrying out field tests, most of this work being done in America, where nylon ropes have been in use for nearly three years. It would appear that they offer promise for elevator work, and general haulage purposes in breweries, warehouses, coal mines and miscellaneous situations where heavy ropes of good quality are employed. For many of these purposes the requirements are for a very strong and highly abrasion-resistant rope; moreover, one that will have a long life. Durability is of great importance, and the long life of nylon ropes is one significant justification of its high price.

Whereas natural fibres as a class are injured to varying degrees by exposure to light which induces oxidation changes of the cellulose molecule, nylon, to a very large extent, is chemically inert, and it is only at high temperatures that it is susceptible to oxidation, and then only after long exposure above 100 deg. C. is there any deterioration of colour. The polyamide is highly resistant to attack by most organic substances, unaffected by alkalis and aqueous solutions of inorganic salts, but dissolved by phenol, *m*-cresol, xylenol, formic acid, oxidizing acids, concentrated hydrochloric and sulphuric acids. It will therefore be realized that there are very few industries where nylon ropes are likely to be adversely affected by contact with raw materials or finished products.

It is not suggested that nylon ropes will entirely supplant those made of manila hemp, sisal and cheaper fibres of natural origin, but there is little doubt that for specialized applications, where price is not of supreme importance, nylon deserves consideration. Apart from ropes, interest is being aroused in the use of braided nylon for hammocks, which are generally made of sisal or manila. Advantages claimed to offset the higher price of nylon include greater strength and durability, with which is coupled the inertness of the fibres to moisture and to attack by fungi, bacteria and insects.

Various types of nylon cordage are shown in the accompanying illustration, reproduced by courtesy of British Ropes, Ltd., Leith. The rope running from the rear, right, to front is a nylon tow rope. On its right is a spool of nylon sewing thread and some coloured cords of decorative value; on the left of the tow rope, the dark spool is wrist-watch strap cord, and the white spool is dressmakers' piping. The two larger white spools in the background are parachute cord; the two coils are glider tow rope and nylon yachting rope. All the hanks are alpine climbing ropes. In the foreground are nylon fishing line and coloured braid.

DR. E. D. KAMM has been appointed to the Board of I.C.I. Plastics Division with effect from September 25, 1947. Dr. Kamm joined I.C.I. nearly 20 years ago, following a research appointment with the Food Investigation Board, which he had held for four years at Liverpool University. His first post was in the Research Department at Billingham. In 1934 he was transferred to Sales Control, London, where he dealt with the distribution of products of the coal-oil plant. In 1941 he became sales manager of the Plastics and Special Products Department in Southern Regional Sales Office, and in the autumn of that year was transferred to Head Office Development Department, where his chief concern was with plastics and with I.C.I.'s assistance to the Government in the replacement of natural rubber. In February, 1943, he went to Welwyn as commercial manager.

New Plastic Tableware

By H. TURNWALD

Translated from "Kunststoffe" by G. HAIM

In this article, published in "Kunststoffe," 1947, Vol. 37, pp. 39-41, the author shows that it is possible to develop plastic "crockery" of such shape and dimensions that there is a notable saving in shipping weight and storage space in comparison with porcelain.

THE acute shortage of moulding powders in Germany will probably prevent their use for the manufacture of tableware in the near future. The present stagnation may be used with advantage to clarify principal questions, for instance, future trends in design; the author hopes that many advantages will be found when comparing plastics with porcelain or glass for use in tableware. One of the greatest advantages is the saving in weight and storage space due to very compact stacking. A few of the paramount advantages are illustrated by practical examples.

On account of its better durability, thick-walled china is used in restaurants, canteens, ships and youth hostels. Although heavy in weight and taking a lot of storage space, it is not always capable of enduring prolonged heavy wear and tear. Plastic tableware is considerably lighter and may be stacked on a much smaller space if it is properly designed. It has the further advantage of possessing a better impact strength than china. These advantages have been recognized by designers of tableware at an early date. Unfortunately, in most cases, it has not been possible to find a shape which would satisfy the requirements of the moulder and at the same time possesses strength and avoid accumulation of dirt.

The designs shown in this article are an attempt to avoid past mistakes and errors and try to introduce many improvements which eventually may contribute to a far larger use of plastics. Some of these models will be of interest for household use.

The proper choice of the moulding material is, of course, of first-grade importance. For this reason phenolic moulding powders are out of the

Fig. 1.—Plastic cups and saucers, as stacked.

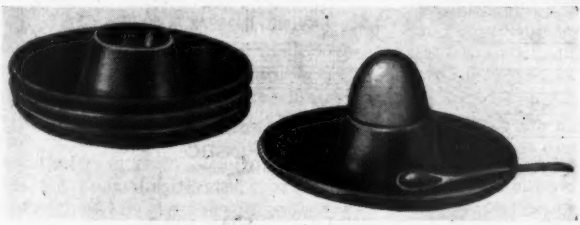


Fig. 2.—Plastic egg-cups, shown also as stacked.

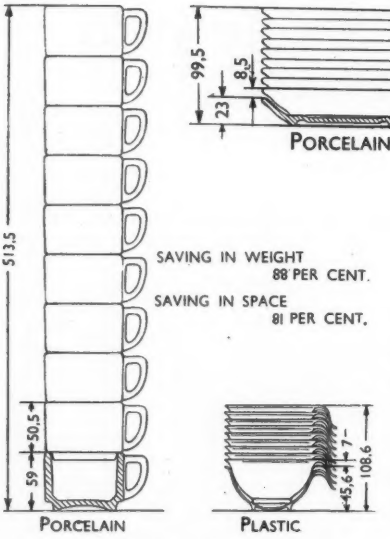


Fig. 3.—Comparison between volume and weight of porcelain and plastic cups.

Porcelain : Volume, 14.8 cu. ft. per 1,000 ; weight, 626 lb. per 1,000.
Plastic : Volume, 2.8 cu. ft. per 1,000 ; weight, 89 lb. per 1,000.

question, but urea-formaldehyde moulding powders should be suitable. The use of pastel shades will contribute a great deal to influence some of the strongest opponents of plastics.

A comparison between china and plastics proves that great economies in weight and storage space can be made. This becomes quite evident when one considers, for instance, the case of a medium-size ocean-going steamer which

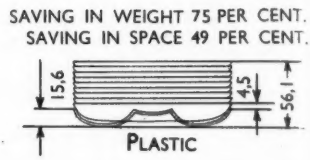


Fig. 4.—Weight and volume of porcelain saucers (left) compared with that of plastic saucers (right).

Porcelain : Volume, 4.9 cu. ft. per 1,000 ; weight, 399 lb. per 1,000.
Plastic : Volume, 2.5 cu. ft. per 1,000 ; weight, 102 lb. per 1,000.

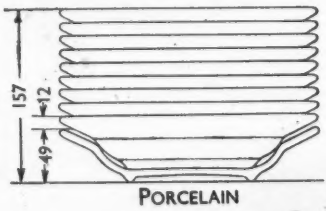
carries more than 10,000 cups. The weight of china cups amounts to approximately 3 tons, whereas the same number of plastic cups weighs barely 7 cwts.

CUPS.—The design of the cup shown in Fig. 3 is the result of prolonged studies and combines suitability for moulding and usefulness.

This is particularly the case with the handle. Obviously such a handle ought to be open at its lower end to permit proper nesting. It should also enable the user to lift it easily. Uniform wall thickness (important for the moulder) and ease of cleaning have also been considered. The peculiar shape of the upper rim was not only dictated by strength and usefulness, but mainly by consideration of mouldability.

The spherical shape of the body permits better cleaning and proved to be more suitable for moulding. The base of the cup is a perfect fit to the saucer.

SAUCERS.—To assist moulding a uniform wall thickness was adopted. To maintain this uniform wall thickness the



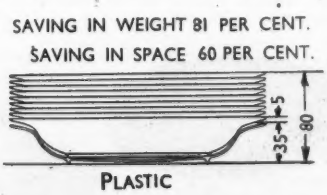


Fig. 5.—Porcelain soup plates (left). Plastic soup plates (right).

Porcelain plates : Volume, 20 cu. ft. per 1,000 : weight, 1,658 lb. per 1,000.
Plastic plates : Volume, 8 cu. ft. per 1,000 ; weight, 313 lb. per 1,000.

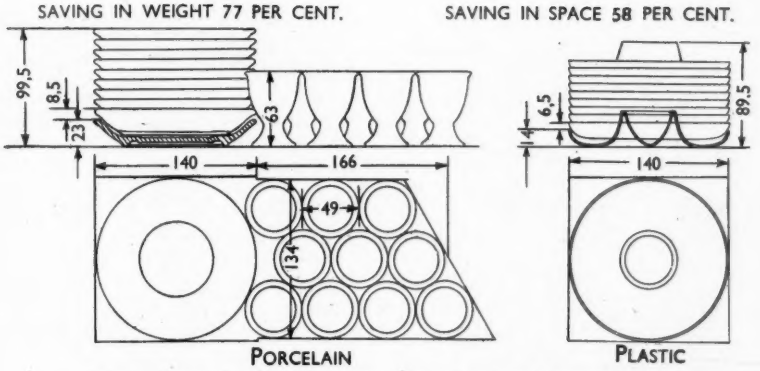


Fig. 6.—Porcelain egg-cup compared with new type of plastic egg-cup.

Porcelain: Volume, 11 cu. ft. per 1,000; Weight, 516 lb. per 1,000.

Plastic: Volume, 4.7 cu. ft. per 1,000; Weight, 119 lb. per 1,000.

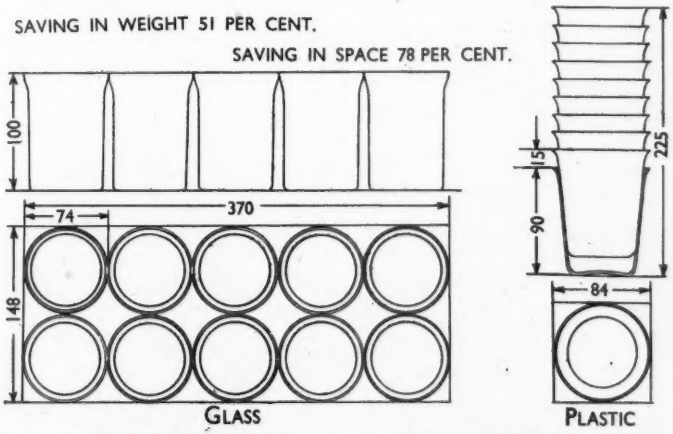


Fig. 7.—Glass beakers and new type of plastic beaker.

Glass: Volume, 19 cu. ft. per 1,000; Weight, 218 lb. per 1,000.

Plastic: Volume, 4.2 cu. ft. per 1,000; Weight, 106 lb. per 1,000.

rim underneath the saucer, usually found on porcelain saucers, was eliminated.

Fig. 4 shows the design of the plastic saucer, which resembles a shallow dish. It can be moulded without complications; stresses in the moulding are eliminated. The raised centre of the cup is a considerable improvement. Any spilled liquid is collected in such a way that it cannot wet the underside of the cup. Proper seating between cup and saucer facilitates transport from the kitchen counter to the consumer and should prove an advantage on board ship, where the balancing of trays is always difficult.

SOUP PLATES.—The form of the plastic soup plates shown in Fig. 5 is not much different from the usual type of china ones. The considerable reduction in wall thickness results in a saving in space and weight.

EGG-CUPS.—Porcelain egg-cups cannot

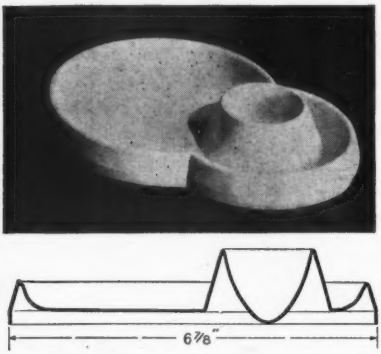
be nested. The moulding of plastics which allows the manufacture of articles with very close dimensional limits made for the first time production of such an egg-cup possible. The new design (Fig. 6) combines egg-cup and saucer. The particular shape adopted allows enough space for a second egg without obstructing the proper handling of the first one.

BEAKERS.—Plastic beakers are not exactly news, but most of the older designs did not fulfil their purpose. They were normally too dead and too narrow so that cleaning was possible only by means of a small wooden stick. The base corners were not always sufficiently radiussed, with the result that dirt collected in the crevices. The rim, too, was very often too sharp edged and did not fit the shape of the lips.

All these faults have been eliminated in the design shown in Fig. 7. The advantages for stacking, transport and, last but not least, for moulding, are evident.

New British Design

As a corollary to the above description of space-saving methods in design, we were interested to encounter a British example of work on the same problem.



The accompanying illustration shows a "urea" resin moulding for a child's egg-cup and plate combination. There is obviously room for development to a wider public.

The form of the egg-cup itself is very similar to that previously described, and we can presume that the "segmented" plate for bread and butter is a sensible and useful addition. The general construction of the underpart has also been constructed for ease of stacking although, obviously, we think, the nesting would not be as perfect as that of the simple German example, since the centre of gravity of the British moulding is outside the centre of the egg-cup itself.

Plastics in Germany

F.I.A.T. Final Report 935.—Methods used by the I.G. at Ludwigshafen for the production of the vinyl esters of higher molecular weight organic acids by reaction with acetylene are herein described. Vinyl benzoate was made in a semi-commercial plant; the vinyl ester of "tall oil" acid was made as a commercial product. Three processes are described: batch Autoclave, vapour phase continuous, and semi-continuous liquid phase. The vapour phase continuous process for vinyl benzoats is covered by German patent No. 740,678.

F.I.A.T. Final Report 1041.—At the I.G. plant at Schkopau styrene was polymerized by a batch emulsion process. The latex was coagulated with formic acid, filtered, compacted on an Aeroform press and dried in a tray drier. The dried lumps were packaged in paper bags and sent to Troisdorf as polystyrene E.F. (emulsion film); it was there sheeted in 140-degree rolls, broken up and ground to be sold as moulding powder under the trade name "Trolitul."

B.I.O.S. Final Report 1161.—The emulsion polymerization of vinyl acetate was carried on at the I.G. works at Hochst in a modern plant which was completely undamaged by bombing. This report gives a detailed survey of the process, with much useful data, for an output of 1,000 tons per month. The general flow of materials and normal conditions in the process are indicated on a flow sheet.

This crozier is apparently unique among ecclesiastical ornaments, for it is executed entirely in "Perspex." It is the work of Josephine Alys de Vasconcellos (Mrs. Delmar Banner), the sculptress, for presentation to the Bishop of Bristol, Dr. F. A. Cockin, who, as Canon of St. Paul's Cathedral, was well known to Londoners in the days of the blitz. Shaped in traditional style, 6 ft. 1 in. in length, it has a delicately carved figure of an angel in the crook.

Cellulose Acetate Plastics

VI.—Plasticizers

By
Vivian Stannett

UNPLASTICIZED cellulose acetate is too brittle to be useful in the form of film, and is not sufficiently thermoplastic to be formed or manipulated by other techniques. It does soften when heated, but is without the necessary degree of flow to be readily manipulated or moulded. In addition, its discoloration and decomposition points are uncomfortably near to its softening point. These disadvantages are completely overcome by the incorporation into the composition of suitable plasticizers, and it is in the plasticized form that cellulose acetate is always found in plastics; nearly always, would perhaps be more accurate, as, very occasionally, unplasticized films are found to be of use where their comparatively high softening point is of more importance than flexibility.

One of the chief functions of plasticizers for cellulose acetate, then, is that of lowering the softening point to a reasonable figure, well below the point where discoloration or other ill effects are liable to occur, and also to increase the degree of flow, that is, to lower the viscosity of the plastic at the softening temperature. Another important function of the plasticizer is to give increased flexibility to the product, and also, to a certain extent, increased toughness or resistance to shock. Plasticizers also help in the manufacture of the plastic base by causing the mass to gel to a homogeneous whole, and so aiding in the working up of the plastic mix, prior to the sheet or moulding powder formation. Certain specific plasticizers are also found to be valuable in imparting many other properties to the finished plastic, such as fire resistance and improved water-resisting qualities.

The generally accepted molecular picture of cellulose acetate was sketched in the second article of this series, and the unplasticized polymer was seen to consist of long molecular chains of varying lengths, lying in part ordered and part disordered fashion. That is to say, some ordered regions occur where the long chains are aligned in a fairly regular fashion and show definite crystallinity. These regular bundles are termed crystallites or micelles. It was also pointed out that a high degree of attraction exists between neighbouring molecular chains and it is this strength of cohesion which is thought to account for the remarkably high tensile strength of cellulose and cellulose acetate fibres and films. In this respect, of course, the powerful forces of interchain attraction give rise to very desirable results, but for some reasons, it is necessary to diminish them.

Extensibility, flexibility and other similar properties are thought to be due to the sliding over one another of the molecular chains when the plastic body is under stress. Consequently, these properties tend to improve with the separation of the molecular chains and the consequent diminution of the forces holding them together. Similarly, the separation of the chains gives a less rigid system, with more freedom of movement to the chains; this gives rise to a greater reduction of viscosity or softening when the plastic mass is heated, in other words, increased thermoplasticity.

The simplest and most effective way of separating the molecular chains is by the introduction of plasticizers. Plasticizers are organic compounds of low volatility, which have a very high power of attraction for the fringes of the cellulose acetate molecule. Consequently, these compounds have the power of over-

coming the forces of attraction holding the polymer molecules together, and entering between the chains. This involves the partial solvation of the side groups of the chain. This causes separation of the chains both by physical means and by increasing the bulk of the acetate groups. The small plasticizer molecules are also often described as acting as lubricants, enabling the chains to slide freely one over the other, but, in general, the method of lubrication would appear to be simply to reduce the power of cohesion between the chains in the manner described.

The degree of separation of the chains will depend very largely on the proportion of plasticizer present, an increasing amount leading ultimately to a liquid solution. In fact, many plasticizers can be simply regarded as non-volatile solvents. Alternatively, a normal volatile solvent for cellulose acetate can be regarded as a temporary plasticizer and small amounts of residual solvent are found to act effectively as plasticizers until their eventual expulsion, due to evaporation. The plasticized cellulose acetate can then be considered as a solid solution of plasticizer and polymer.

Plasticizers are often divided into two classes: solvent or gelatinizing types, and non-solvent or non-gelatinizing types, the latter sometimes being referred to simply as "softeners." Solvent types are regarded as true solvents for the polymer and have the greatest power of solvation of the side groups of the long chain molecules. Non-solvent plasticizers have often been described as liquid fillers or extenders and depend to some extent on mechanical and physical modes of action as lubricants. There is, however, no sharp distinction between the two classes, but rather a gentle gradation between the two extreme types.

It is often considered that non-solvent types depend for their action on the retention of small amounts of solvent. They are often used mixed with solvent types when they can be regarded as non-volatile diluents or co-solvents. In these cases it is thought that the non-solvent type is held by its attraction for the solvent plasticizer, the latter retaining its attraction for the polymer chains, and the non-solvent simply exerts a spacing effect. In this way mixtures of solvent and non-solvent plasticizers are often found to be superior to a single plasticizer of the solvent type. Non-solvent plasticizers used alone often cause swelling, but no solution or gelling of the polymer.

With partly crystalline polymers such as cellulose acetate it is thought that a plasticizer may or may not penetrate into the micelle itself, depending on its molecular size and its power of attraction for the polymer molecule. In other words, both inter-micella and intra-micella penetration can occur. This particular aspect of plasticization has not yet been fully investigated, but it is obvious that the poorer solvent type will merely penetrate the amorphous regions.

A useful practical method of testing the miscibility level of plasticizers and polymers is to simply mix them together and observe whether any swelling or dispersion occurs. This method has been considerably developed and extended by Jones.[1] He divides the results of his observations into the following four practical classes or degrees of mixing:—

(1) gg, good gelling when swelling and dispersion to a clear homogeneous solution take place in a matter of a few hours. This constitutes unlimited miscibility.

(2) g, gelling of an inferior type, characterized by a cloudiness of the solution and a certain lack of homogeneity due to the presence of the original grain structure of the polymer. Even in this

Table I.—Qualitative Miscibility Tests of Plasticizers and Cellulose Acetate. (Jones [1])

Plasticizer	Degree of miscibility
Dimethyl phthalate	gg.
Diethyl phthalate	gs.
Dibutyl phthalate	gs.
Diamyl phthalate	gn.
Dimethyl glycol phthalate	gs.
Trimethyl phosphate	gg.
Triethyl phosphate	gg.
Tributyl phosphate	gn.
Tricresyl phosphate	gn.
Trichlorethyl phosphate	gg.

Table 2.—Physical Properties of Cellulose Acetate Plastics made with different Plasticizers. (Gloor and Gilbert [2])

Plasticizer	% by weight	Hardness Rockwell M	Charpy impact notched ft.-lb./sq. in.	Elasticity modulus lb./sq. in.	Flexural strength lb./sq. in.
Triacetin	30	36	8.46	243,000	7,360
Tributyrin	30	52	15.4	171,000	2,700
Methyl phthalyl ethyl glycollate	30	59	6.5	278,000	8,100
p-Toluene ethyl sulphonamide	34	90	0.8	258,000	6,750
Triphenyl phosphate	30	60	4.2	284,000	8,900
Dimethyl phthalate	34	32	5.9	175,000	5,900

case the miscibility of the plasticizer with the polymer may be several hundreds per cent.

(3) gs, slight gelling or swelling of a limited nature with definite evidence of two phases which appear to comprise liquid plasticizer and swollen grain of polymer. In this case the miscibility may be of the order of 50-100 per cent. by weight.

(4) gn, no gelling. The polymer may be wet out and small amounts of plasticizer may actually have mixed with the polymer, e.g. up to about 50 per cent. by weight.

Some of his results for some typical plasticizers with cellulose acetate are quoted in Table 1.

Effect of Type and Quantity

As would be anticipated from simple theoretical considerations, the effect of plasticizers on the physical properties of the plastic varies both with the type and the amount of plasticizer present. Different plasticizers are found to produce a very different order of modification of the plastics properties. For example, it is found that a cellulose acetate moulding powder containing 28 per cent. of one particular plasticizer has the same flow temperature as one containing 35 per cent. of another; that is, with exactly the same grade of acetate being used in each case. Differences in the extensibility are often even more marked, and the same proportion of plasticizer can give elongation figures, varying from about 10 to 25 per cent., using different plasticizers.

Some of the variations in the physical properties of cellulose acetate plastics containing the same proportions of different plasticizers are shown in Table 2. In spite of these variations, plasticizers are rarely selected for these reasons, but rather on economic considerations of availability and cost. The differences in the physical properties of the plastic brought about by varying the proportion of plasticizer present, however, are ones which are made great use of in formulating commercial compositions. In fact, many commercial cellulose acetate plastic grades often vary from one another only by virtue of the different proportions of plasticizer present, and this is true of sheet and film as well as of injection moulding powders and extrusion compounds. This does not mean, of course, that special grades are not specially plasticized with plasticizers specifically selected for particular purposes. They are, but in a graded series of general purpose plastics, it is the proportion of plasticizer which usually varies and not the species.

Table 3.—Variation of Physical Properties with Plasticizer Content. (Fordyce & Meyer [3])

Plasticizer : Dimethyl phthalate

Parts plasticizer per 100 parts cellulose acetate	37.8	30.0	22.6
Flow temperature, °F.	266.0	285.0	307.0
Elongation, %	8.0	6.5	5.0
Tensile strength, lb./sq. in.	6,630	8,100	9,930
Flexural strength, lb./sq. in.	11,140	14,200	17,000
Rockwell hardness, M	79.5	90.5	101.1
Water absorption, %	2.13	2.47	3.24
Leaching (48 hrs.), %	0.58	0.52	0.45
Loss in weight (1 week, 150°C.), %	2.40	0.86	0.53
Shrinkage (1 week, 150°C.), %	1.38	0.11	0.09

Some of the variations of physical properties with the proportion of plasticizer are shown in Table 3. It is clearly

seen that as the proportion of plasticizer increases, softening point and flow temperature become lower and the plastic becomes progressively softer and more extensible.

On the other hand, certain characteristics, such as tensile, flexural and impact strengths, decrease somewhat, although not to a really significant degree compared with the improved flow characteristics and their relative importance for most commercial applications. The effect of varying the proportion of plasticizer on the flow characteristics is well illustrated by the diagram given in Fig. 1. This shows the variation of actual viscosity of the plastic with temperature for cellulose acetate plastic strips containing different percentages of the same plasticizer. Owing to the hydrophobic nature of many plasticizers, increased plasticizer content often leads to lower water absorption, as the figures given in Table 3 testify. One adverse effect of increasing the plasticizer content is shown by the greater shrinkage which is found to occur, and this is undoubtedly connected with loss of plasticizer due to gradual evaporation.

Choice of Plasticizer

A number of factors have to be taken into account when selecting a plasticizer for commercial use. Reed has recently published[5] a very complete list of those factors which he considers to be of importance, and this list is reproduced in Table 4. Before commercial use, therefore, the plasticizer needs to be tested, and the results considered, to see if it will fulfil the requirements necessary under

Table 4.—Important Factors in Evaluating a Plasticizer for Commercial Use. (Reed[5])

Compatibility	Physiological properties—
Ease of incorporation	Odour
Permanence—	Taste
Volatility	Toxicity
Water extraction	Economic factors—
Oil extraction	Cost
Migration	Availability
Chemical stability	Special factors—
Plasticizing efficiency—	Inflammability
At normal temperature	Electrical properties
At sub-normal temperature	Colour
	Effect on resin stability

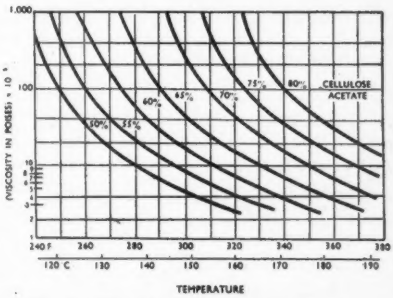


Fig. 1.—Viscosity-temperature characteristics of cellulose acetate plastics of several plasticizations with methyl phthalyl ethyl glycolate.

these headings in actual use. Some of the more complex of these factors will now be discussed in detail.

COMPATIBILITY.—For some formulations for cellulose acetate plastics, a very large proportion of plasticizer is found to be necessary to give the required properties, and in these cases compatibility is of major importance. For most commercial uses, however, moderate proportions only are employed, and one would consider that in these cases compatibility would be only of secondary importance compared with the case of, say, the vinyl resins, where a very high proportion of plasticizer is habitually used. However, owing to the poor compatibility of most plasticizers with cellulose acetate, this topic is a highly important one, and a maximum compatibility figure for each plasticizer should be known. If this value is exceeded, the results are very apparent. For example, films dry out in a cloudy and opaque condition, with a poor tearing strength, or, in less extreme cases, whiteness is produced on bending or even occasionally on rubbing.

Luckily, a few plasticizers do exist which have a really high compatibility with cellulose acetate, and these are used to compensate for the comparatively low compatibility of others. This is to say, valuable plasticizers which have only a low compatibility can be used in conjunction with a highly compatible plasticizer, as already discussed earlier in this article.

Table 5.—Compatibility of Plasticizers with Cellulose Acetate (medium acetyl.) (Fordyce & Meyer [3])

Plasticizer	Maximum compatibility	Maximum permanent compatibility
	Parts per 100 C.A.	Parts per 100 C.A.
Butyl phthalyl butyl glycollate	50	50
Diethyl phthalate	90	30
Dimethoxy ethyl phthalate	100	25
Dimethyl phthalate	100	15
Ethyl phthalyl ethyl glycollate	100	40
Methyl phthalyl ethyl glycollate	100	40
o.p.-Toluene ethyl sulphonamides	100	35
Triacetin	100	12
Tricresyl phosphate	20	20
Triphenyl phosphate	50	30

In this case, the solvent type are, of course, the compatible plasticizers, whilst the low compatibility plasticizers can be regarded as non-volatile diluents or co-solvents. A simple example is to be found in the use of a mixture of triphenyl phosphate and dimethyl phthalate, which is one of the commonest of all plasticizer combinations for cellulose acetate plastics.

Triphenyl phosphate is a very valuable plasticizer, conferring, among other advantages, a high degree of non-inflammability on the plastic. Unfortunately, used alone, it has a relatively low compatibility, and it is not usually regarded as safe to use more than, say, 10 to 20 per cent. Coupled with dimethyl phthalate, however, rather larger proportions can be used without risk of opacity or other consequences of exceeding the compatibility limit. In this particular case it should be pointed out that the dimethyl phthalate exerts an important second effect, in that it confers a higher measure of plasticity than does triphenyl phosphate, and the two plasticizers are largely complementary in action, in addition to the compatibility aspect.

Some workers have made a distinction between maximum compatibility and maximum permanent compatibility. The former is simply the proportion of the plasticizer which can be incorporated into the plastic without risk of exudation, whitening, etc., whereas the latter is that proportion of plasticizer which remains a more or less permanent part of the plastic composition, even on prolonged ageing. This can be determined by measuring the loss of plasticizer which occurs on prolonged heating, immersion in water, or under any conditions which may be prescribed. The proportion of plasticizer is then plotted against time. It is found that a fairly rapid loss of plasticizer occurs for an initial period, and then the curve straightens out to an extremely slow and steady loss value. The maximum permanent compatibility is then determined by extrapolating back the flat portion of the curve.

Some values determined by Fordyce and Meyer for various plasticizers in cellulose acetate film are given in Table 5. This value is of particular importance, as the rapid loss of plasticizer on ageing is accompanied by substantial shrinkage and consequent distortion of the plastic article.

PERMANENCE.—One aspect of this question has already been mentioned above in connection with permanent compatibility measurements. It is found that, as would be anticipated, plasticizers with a high vapour pressure are the most volatile, and this, of course, is particularly apparent when ageing at elevated temperatures. The volatility of plasticizers is not always of importance; for example,

Table 6.—Effect of Type and Proportion of Plasticizer on Elongation of Cellulose Acetate Films.[4] (Figures refer to percentage elongation)

Per cent. plasticizer in film	Santicizer B.16 (Butyl phthalyl, butyl glycollate)	Santicizer E.15 (Ethyl phthalyl, ethyl glycollate)	Santicizer M.17 (Methyl phthalyl, ethyl glycollate)
0 (control)	2.3	2.3	2.3
25.0	6.0	5.7	10.0
50.0	12.3	14.7	24.7
75.0	13.3	28.0	35.3

Table 7.—Effect of different plasticizer on flow temperature.[3]

Flow temperature	Percentage plasticizer		
°F.	Dimethyl phthalate	Diethyl phthalate	Di(methoxyethyl) phthalate
266.	37.8	59.5	62.5
285.	30.0	49.0	51.3
307.	22.6	38.7	39.6

Table 8.—Relative Inflammability of Cellulose Acetate Films containing different Plasticizers.[7]

Plasticizer 30% on weight C.A.	Film thickness (mils)	Time of burning (seconds)	Distance burnt (ins.)	Demerit figure
Dimethyl phthalate	6	19	All consumed	190.00
Diethyl phthalate	6	20	All consumed	200.00
Dibutyl phthalate	5	20	All consumed	200.00
Tributyl phosphate	6	4	0.5	2.00
Triphenyl phosphate	7	6	0.5	3.00
Reomol N.F.1.	6	1	0.5	0.5
Reomol N.F.2	6	5	0.75	3.75

in the use of plastic sheets for safety glass interlayers where the plastic surfaces are virtually completely enclosed. Similarly, of course, sheet plastics is more subject to loss than moulded articles which have a comparatively small surface area. The vapour pressure of the plasticizer in its free state is a useful indication of its volatility in the plastics mass, although the fact of maximum permanent compatibility should be borne in mind when considering this. Many methods of measuring the loss of plasticizer from the plastic composition have been devised, ranging from simple heating methods to complicated apparatus for determining the loss of weight in a stream of air of controlled temperature and humidity.

In connection with the loss of plasticizer by evaporation, possible losses due to leaching out of the plasticizer by water, oil and other solvents should also be considered. Generally speaking, the solubility of the free plasticizer in water, or the solvent concerned, gives an excellent indication of its loss value from the plastic body. To summarize, one can say that the permanence of a plasticizer in the plastic composition can be roughly forecast from a knowledge of its vapour pressure at the ageing temperature, its maximum permanent compatibility, and its solubility in water or other solvent to which the plastic is liable to be exposed.

PLASTICIZING EFFICIENCY.—The measure of the efficiency of a plasticizer has been the subject of a considerable amount of work and controversy. A good practical method, however, for most purposes, is to find the proportion required to give a standard extensibility under a particular load and loading rate, and this method can be extended to give a measure of low temperature flexibility. Other methods proposed have been to measure the lowering of viscosity which occurs when a standard amount of the plasticizer is added to a standard amount of the polymer, dissolved in a suitable solvent. Similarly, the proportion of plasticizer required to give a particular and specified flow temperature can also be used as a measure of plasticizing efficiency.

The figures given for three plasticizers by Fordyce and Meyer quoted in Table 7, are of interest in this connection. A further set of figures, comparing three commercial plasticizers and the percentage elongation found for cellulose acetate film, containing different proportions of these plasticizers, are given in Table 6. These show well the marked difference in "efficiency" between these plasticizers, an approximate deduction showing that to produce an elongation of 12 per cent. in each case the percentage of plasticizer needed varies between about 28 per cent. and 50 per cent. for the two extreme values.

INFLAMMABILITY.—One of the most

important functions of certain plasticizers for cellulose acetate is to reduce the inflammability of the plastic. This is particularly important for film and sheeting, although it is also important for many moulded articles, and recently flameproof moulding of cellulose acetate have been marketed.

Normally, the inflammability of cellulose acetate plastics depends on the plasticizer. Unplasticized cellulose acetate burns very slowly, at a somewhat slower rate than paper or wood. When incorporated with a plasticizer, such as dimethyl phthalate, the plastic is found to burn quite fiercely. However, if a fire-retarding plasticizer, such as triphenyl phosphate, is used the inflammability is considerably reduced, and when a reasonably high proportion is incorporated, the plastic becomes virtually non-inflammable. Tricresyl phosphate and trichlorethyl phosphate also show marked fire-retarding properties.

A simple method of comparing these properties has been devised by The Geigy Co. This test consists of timing the burning of a standard size piece of film, ignited under standard conditions. The product of the distance burnt before the flame extinguishes itself and the time taken for this burning, is taken as the figure of demerit. Typical figures are quoted in Table 8. The properties of some typical plasticizers commercially used for cellulose acetate will be discussed in the next section of this series.

(To be continued.)

REFERENCES

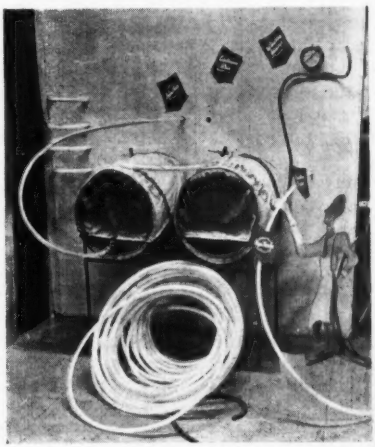
(1) *Jones, I.R.I.Trans.* (1946), 21/5/298. **(2)** *Gloor and Gilbert, Ind. Eng. Chem.*, 1941/**33**/597. **(3)** *Fordyce and Meyer, Ind. Eng. Chem.*, 1940/**32**/1053. **(4)** *Fleck, "Plastics, Scientific and Technological," 2nd ed., page 178.* **(5)** *Reed, J. Polymer Sc.*, 1947/**2**/115. **(6)** *Monsanto Chemical Co., Technical Data.* **(7)** *The Geigy Co., Technical Data Sheets.*

Polythene Piping for Beer

We are being treated to a preview of current trends in design and usage by a sequence of exhibitions. Following closely on the heels of the British Industries Fair have come the Engineering and Marine Exhibition, "Industrial Wales," "Enterprise Scotland," and the doors have just closed on "Radiolympia." It has been an interesting season of exhibitions and we have been duly rewarded in the search for plastic goods which were new to us, or concerning which we had something useful to learn.

When we went in search of plastics at the recent Brewers' Exhibition, we did so more assuredly than many might have done, for we had forewarning of finding extruded polythene piping, with special connectors, for use in delivering beer direct from barrel to bar, and in this service proving a great improvement on materials hitherto employed. This polythene piping is already in use by many of the leading brewers throughout the country. Its great advantage is complete cleanliness, as the inner surface of the pipe has a glass-like finish which will not harbour dirt or germs.

The accompanying illustration shows part of the exhibit by Tenaplas, Ltd., of Upper Basildon, near Pangbourne, Berks. "Tenaplax" beer piping has all the characteristics ideally required of a piping to convey other liquids for human consumption. In use for beer, cleaning is easily effected by a weekly pull-through of common salt in water. The piping is flexible, yet rigid enough to retain its internal bore; any tendency to crush when trapped will not damage the pipe.



Substitutes for Timber

WITH the present serious shortage of timber, as an aftermath of the war years, when available supplies were utilized ruthlessly without one thought being given to possible requirements of the future, it was not unexpected that a determined effort would be made to find some convenient substitute. To be of any real service, such a substitute had to be comparatively cheap, efficient for its purpose, and certainly capable of mass production. It was here that our present knowledge of synthetic resins as bonding materials was convenient to draw upon, and companies operating in Britain were soon making various kinds of composition board on large or small scale.

In our September issue we referred to a new process for manufacturing such building board from wood waste by the application of dielectric high-frequency heating, the wood waste being bonded by synthetic resin which cures under the heat applied simultaneously with pressure when consolidating the waste into a rigid board, which has all the desirable properties of wood as a structural material, and certain advantages added. Our description of the process was based mainly upon experiments which had been carried out in Sweden. At the time of writing, we were aware that a product very similar in character was being placed on the market here, but were unable to elaborate further upon this new British product in the absence of having fuller details. These details have now come into our hands. The new material is called "Plimber," and is a product of British Plimber, Ltd., of London. Described as a plastic composition board, consisting largely of wood fibres which are chemically treated and bonded with synthetic resin, it claims to be the only board of its kind manufactured in a range of thicknesses from $\frac{5}{8}$ in. to $1\frac{1}{4}$ in., increasing by $\frac{1}{8}$-in. stages.

Unlike many plastic composition products, "Plimber" can be easily sawn, cut by other means, drilled, nailed, and treated the same as timber in almost every other way. Sheets are manufactured in sizes up to 8 ft. 6 ins. by 4 ft. The thermal and sound-insulating properties are said to be excellent. In colour, the board is more or less the natural colour of the wood from which it is made—a buff or creamy brown, or a so-called standard utility shade. At the moment it is being produced at factories in London and Yarmouth, but plans are in hand for a further factory shortly to commence operations, and others are projected in the neighbourhood of Cardiff, Wigan and Glasgow, where they will absorb available supplies of waste wood and distribute the finished product more conveniently in directions where most needed.

The present variety of "Plimber" which is in production is being marketed as "Plimberwood." It weighs about 40 lb. per cu. ft., or $3\frac{1}{2}$ lb. per sq. ft. for a thickness of 1 inch. When thoroughly seasoned, the 1-in. board has a mean modulus of rupture (dry) of 530 lb. per sq. in. Tested for transverse strength, the breaking load (dry) is 250 lb. per sq. in. Deflection (dry) is 0.01 in. with a load of 10 lb. applied for 30 seconds. Regarding impact strength, there is no visible sign of damage to the face of the board by dropping a 2-in. steel ball from a height of 25 ft. "Plimberwood" therefore appears to be strong enough for all practical purposes such as partitions, but has not the transverse strength which is required for spanning beams or for carrying a load.

As delivered from the factory, the board has a moisture content between 11 and 14 per cent.; in use, it gradually attains the moisture content of the surrounding atmosphere. Used at a heat insulating medium, the heat loss is 0.8 B.Th.U. per sq. ft. per inch thickness per hour for each degree F. temperature difference between the faces of the board.

World's Industry Employs Plastics

GENERAL ENGINEERING

Truck wheels of phenol-formaldehyde resin and macerated duck canvas are said to have excellent floor-protective and shock-resilient qualities in factory usage. ("Scientific American," 1947/Nov./230.)

Clamp supports are made of tough plastic with high-tensile and impact strengths. These clamps, with one drilled hole, are intended for mounting wires, cables, tubes and other material requiring small hangers. The supports are good insulators and do not sweat. ("Product Engineering," 1947/Sept./188.)

Wear tests on plastics, determined by the Sko-da-Sawin wear-testing machine, are described by N. N. Sawin ("Maschinenbau and Waermewirtschaft," 1946/Nov.-Dec./103; "Engineers' Digest," 1947/Oct./333). Mainly laminated materials, as well as plywood and scraps of plywood, were investigated. The powdered wear particles of the test bar act as the principal factor in the formation of the impression, which is considered as the measure of wear.

Grinding Wheels.—German methods for the production of Bakelite-bonded diamond grinding and lapping wheels, by Gebr. Funke, Leichlingen, and E. Winter and Sohn, Hamburg, have been recorded in B.I.O.S. Report 1448 ("The German Industrial Diamond Industry"), published by H.M. Stationery Office.

Foundry Patterns.—The technique of making foundry patterns from phenolic resins is described by E. J. McAfee ("American Foundryman," 1947/**12**/26.)

Strength of Mouldings.—Investigations by W. Weigel on the strength and structure of compression and transfer mouldings ("Kunststoffe," 1947/Jan./11) have been abstracted by "Engineers' Digest" (1947/Oct./336).

Laminated plastic guide ways on an open-side planer, by G. A. Gray Co., have a load-carrying capacity of 50 lb./sq. in. at a speed of 400 ft./min., compared with only 20 lb./sq. in. for cast iron. ("Product Engineering," 1947/Sept./101.)

Split Plastic Tube.—Interesting experiment with plastic tubing has recently been described ("Science Illustrated," 1947/Oct./94). The tube is cut open lengthwise with a hacksaw. By heating it is then flattened to a sheet, and set. If now placed under an infra-red lamp, the sheet tends to curl and takes up its original shape, the saw-cut space remaining.

Data on general properties and uses for moulded plastic materials of phenol-resin basis have been compiled ("Machinery," (New York), 1947, Data Sheets 593, 594)

ELECTRICAL

Portable electric leads with a neoprene rubber jacket to provide increased protection against abrasion and other damage, have been introduced by United States Rubber Co These cables can sustain increased flexing ("Tool Engineer," 1947/Oct./22.)

Electrical insulating materials are surveyed by B. R. E. Wandeberg from point of view of dielectrics. Tabular data, useful for the designing electrical

engineer, is presented, but must not be considered as "standards." ("Kunststoffe," 1947/May/97.)

MISCELLANEOUS

Safety goggles with "Tenite" frames have been developed by the Tennessee Eastman Corporation; they are claimed to be extremely light in weight. ("Scientific American," 1947/Nov./228.)

Slide Rules.—N. G. Near has made a magnifying slide-rule cursor of clear $\frac{1}{16}$-in. "Perspex," cut to shape, to which a second piece of "Perspex," $\frac{3}{16}$-in. thick, is glued by the aid of glacial acetic acid. The cursor is polished semi-cylindrically. ("Mechanics," 1947/Oct. 10/451.)

Table Tops.—The Goodchild Plastics Co. offers card-table tops moulded in one piece from phenolic resin. They weigh 10 to 12 lb. each and are considered to be the largest area parts so far produced in the American plastics industry. ("Scientific American," 1947/Oct./174.)

Heat Sealing.—Eastman Kodak Co. have developed a high-frequency generator for the sealing of plastic boxes without use of cement. The method is expected to reduce waste, give improved appearance, and lead to a greater uniformity of the product. Distortion, frequently due to cements, is not caused. ("Scientific American," 1947/Oct./172.)

Tennis Rackets.—The production processes involved in the manufacture of modern laminated tennis-rackets are described by J. N. Tynan. Rotary-cut veneers have not proved very suitable for high-class productions. The rackets described are produced by sawing from second-growth ash, ripped from boards of 1-in. thickness. The laminated frames are steam-bent. No information is given regarding glues. ("Mechanical Engineering," 1947/Sept./735.)

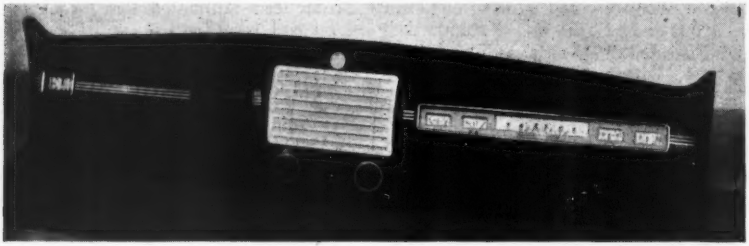
Gramophone Needles.—New use for nylon has been found in the "knee" (bent holder) of a gramophone needle developed by Webster Chicago Corporation and Decca Records Inc. An improved self-damping characteristic is claimed. These needles are equipped with a hand-polished sapphire tip, and said to last for 15,000 playings. ("Scientific American," 1947/Nov./223.)

Silicones.—J. R. Patterson reports on paints, varnishes and enamels produced from silicones. As with other silicone products, they excel in resistance to heat, weather and chemical corrosions. Silicone resins can be used as cold blends with other film-forming materials such as urea-formaldehyde, ethyl cellulose and acrylate resins. Alkyd-silicone-co-condensations have unusual hardness, adhesion, toughness and heat-, as well as chemical-resistance. ("Products Finishing," 1947/Aug./58.)

Plating tank made of high-temperature "Lucite" and intended for laboratory or production plating has been produced by Singleton Co., 9823, Lorain Avenue, Cleveland, 2, Ohio. The special advantage is the transparency, enabling the action of the bath to be observed. ("Products Finishing," 1947/Sept./122.)

SOURCES OF REFERENCE

We wish to remind readers that the sources of reference from which these pages are compiled are not, in general, retained in this office. We cannot, therefore, undertake to supply such originals. Nevertheless, most of the foreign journals referred to are available in the Patent Office Library (Southampton Buildings, Chancery Lane, W.C.2) and in the Science Library (South Kensington). Photo-duplicated copies of articles may be obtained from the Photostat Dept. of the Patent Office.



V.8 Pilot instrument panel for aircraft, with radio grille at centre, by British Moulded Plastics Ltd.

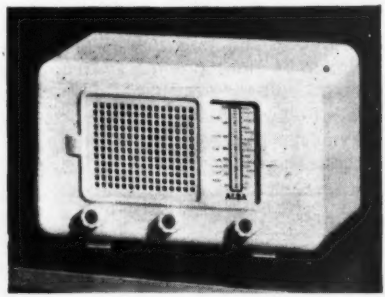
Plastics at "Radiolympia"

ON the day we visited "Radiolympia" there were several million visitors, although authorities will deny this figure. How anybody could examine any individual stand or production in comfort or with care was quite beyond us, for a milling, heterogeneous crowd, complete with babies-in-arms, yelling urchins munching cakes or sandwiches between yells, and mothers feeding their young while taking possession of expensive seats provided by stand-holders for men on business, prevented quiet examination.

Having expended our spleen, we were glad to note the steadily increased use of the plastic radio cabinet, often employed in dignified fashion. Most manufacturers produce at least one plastic type thus, or in combination with wood. Most, too, employed "Perspex," or other transparent plastic, to exhibit the manner in which the interior is assembled.

Of the most noteworthy we saw, Ferguson's 203W, Cossor's two models 470AC and 460, Philips's 209U, 371A, 462A and 170A, Ekco's A44, U49, in addition to a new radio alarm, Vidor's CN360, Pilot's Little Maestro and Ultra's three models in seven colours.

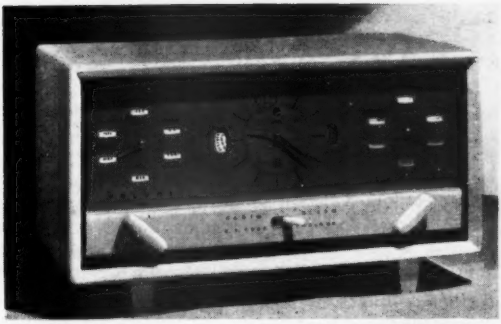
As for plastic manufacturers, British Moulded Products Ltd., showed a vast number of the cabinets it produces, De La Rue Insulations Ltd., its laminates and uses thereof, and Duratube and Wire Ltd., appeared to be "plastic-wiring" the whole world.



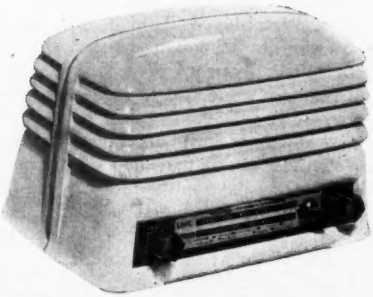
(Above) Midget receiver by A. J. Balcombe, Ltd.

(Left) Battery-operated receiver with moulded cabinet and plastic grille, by Pye Ltd.

An entirely new design in domestic radio ("Champion Venus") by Champion Electric Corporation.

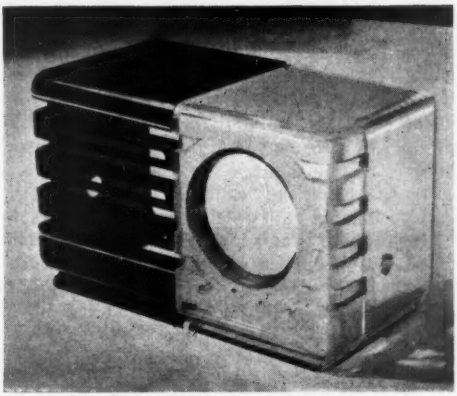


"Ekco Radio-Time," a unique radio-cum-clock with ingenious switch-setting mechanism, cabinet of cream urea designed by Mr. Wells Coates (E. K. Cole, Ltd.).



Radio by Kolster-Brandes Ltd., who supplied broadcast receiving equipment in R.M.S. "Queen Mary."

"Ekco" receiver in cabinet of "walnut" phenol-formaldehyde (E. K. Cole, Ltd.).



Small receiver for bedroom or kitchen, with curved "Perspex" cover for tuning scale (Murphy Radio, Ltd.).

Cabinet made partly of clear "Perspex" to show internal features (Philips Electrical Ltd.).

Polyesters as Casting Resins

By Wentworth Weeks

DEMANDS for laminates in the United States during the war, aided and abetted by the hope of plentiful styrene left over from the synthetic-rubber programme, have given birth to a new family of thermosetting resins which may drastically alter the course of plastics development.

Known somewhat vaguely as "unsaturated polyesters," these resins chemically are alkyds modified by styrene or similarly unsaturated hydrocarbons, with all the complexity and multiplicity of types such ancestry suggests. The styrene-type modifiers provide the cross-linkage between the alkyd chains and earns the thermosetting classification. Liquid monomers are rapidly transformed to solid polymers with the help of peroxide catalysts, with only moderate heat required and entirely without pressure; the reaction is completed without by-products. From their first use in low-pressure laminating—still an important one—they are spreading out into multiple applications as casting resins.

In more than one sense, this use represents the escape of plastics from the machine. Low heat requirements and absence of pressure demands place them outside the realm of heavy industry. Castings are poured in simple, inexpensive moulds of plaster, rubber, low-melting alloys, glass, or even plastics, and no particular skill or specialized equipment is needed. Once development work is completed, almost any amateur will be able to set up shop to turn out plastic articles in sizeable quantities. What he lacks in split-second speed will be balanced by low initial costs and adaptability.

These castings present an astounding range of qualities, varying with the selection of resin, catalyst and curing cycle. They may be as hard as ureas, or almost as flexible as vinyl chloride. Their heat resistance compares favourably with many phenolics. Close to water-white transparency is possible, dyed and pigmented to any degree of colour and opacity. Tensile strength is surpassed only by nylon; compressive strength compares to melamine; impact strength lies in the range of cast phenolic and acrylic, and yet certain resins vary to a flexural strength exceeded only by vinylidene chloride. Water absorption is less than any plastic, other than polystyrene, vinylidene chloride, and polythene. Chemical resistance is high, the main susceptibilities being concentrated alkalis, chlorinated hydrocarbons, aromatics and ketones. Electrical properties are extremely good.

This does not mean that they are the perfect material, or that their use is foolproof. They have grave faults, some of which may be eliminated as work progresses. The hardest types (and the closest to water whiteness) are inclined to be brittle, especially in thin sections. The elastic types, which are really tough gels rather than true elastomers, lack strength and require supporting filler, besides trending toward amber and opaque. The cast resins burn, although flame-resistant (self-extinguishing) types, using halogen-substituted constituents, are available—also at a cost of whiteness.

Since the polymerization reaction is exothermic to varying degrees, each size and thickness of casting offers a special problem in catalysis, which must be piloted to obtain dependable results. There is also a decided shrinkage factor, although less than half that of acrylics, which demands careful mould design or the use of flexible mould materials. With all these shortcomings, however, these new resins still surpass anything hitherto available for casting purposes.

The catalysed resin can be gelled at room temperature, in as little as 3-5 minutes if promoters are used; large batches, mixed to remain stable for days, are gelled with heat of about 50 degrees C. in 10-15 minutes. The castings may be removed from moulds in the gel state—rubbery and flexible, progressing to rigid, but easily cracked or torn—in order to release moulds for new pourings. The final cure takes as little as 15 minutes at 120 degrees C. The only careful control required is during the period of transition from liquid to gel, and this is simple compared to polymerization of alkyls or methacrylates, being compared to hours of days needed for phenolics and furanes.

No one producer of resins has a monopoly upon this type, although laboratory history seldom antedates 1941. Pittsburgh Plate Glass Co., who pioneered the first allyl resins (Columbia series), have now dropped them completely for their Selectrons of this group. Bakelite, Monsanto (Thalids), Du Pont (BCMs) and Plaskon (X-100 series) still think largely in laminating terms. General Electric introduced Textelite 1422, but supply only cast polymer for machining. American Cyanamide with their Laminacs, the Naugatuck Division of U.S. Rubber with their Vibrins, and Resinous Products and Chemicals (Rhom and Haas affiliate) with their Paraplex series are awake to casting potentials, as are a number of more obscure producers. All of these formulations vary, most of the names covering a sizeable group of monomers, but all fit together into a family as distinct as the phenolics or aminoplasts.

The monomeric liquids are usually of low viscosity, or become so when warmed. Heavier syrups may also be diluted with styrene, di-vinyl benzene, or similar unsaturated aromatics, which become active partners in the polymerization—although with corresponding variance from the resin's original characteristics. Peroxide catalysts range from benzoyl peroxide through caprylol and lauryol, with newer liquids, such as t-butyl hydroperoxide and t-butyl perbenzoate, being especially useful. A number of promoters and accelerators may be added to expedite the reaction, or heat serves the same purpose.

This transition from liquid to gel presents the greatest latitude for study. Since the reaction releases heat, its expanding action works counter to the simultaneous shrinkage of forming polymers. Over-catalysation, or two rapid cure, sets up stresses and cracking reminiscent of unfilled ureas. With control, the decorative effects of golden threads and flakes trapped in the transparent body will result.

Tailoring of catalyst content and type, or additional promoters, to the volumetric nature of the casting is a fundamental part of production, both from the standpoint of clearing moulds rapidly and to obtain optimum qualities in the finished casting.

Under-catalysation and slow cures usually give greatest strength. Since multiple moulds are almost axiomatic, the use of heat to gel relatively stable catalyst-resin systems allows ample pouring time and eliminates danger of trapped air bubbles. Another variation involves the use of two mixtures, one a fairly stable catalysed resin and the other a resin-promoter, blending the two during actual pouring and adjusting to set-up as rapidly as desired. Preheating of moulds also speeds up gellation.

Once the gel is formed the resin may be handled with moderate care, and may even be shaped to simple curves that do not exert too great a strain. Removal from the mould at this stage makes possible the use of rigid moulds in many cases, where the completely cured resin would lock or crack itself upon deep detail. Until a really firm gel is obtained, protection from air is advisable to avoid the characteristic tacky surface—attributed either to oxidizing, or the unavailability of styrene content at such

surfaces leaving a film of straight alkyd. Cobalt accelerators or extra curing eliminate this feature, but protection with cellulosic and vinyl films, or the use of mineral oil and glycerine baths during cure, seal out the air. With all except the most flexible resins, a gel sufficiently strong to be cured unsupported can be obtained, but jigs holding multiple castings can be used for exceptions.

This stage of gellation has other advantages. Assembly of parts using additional resin as an adhesive is quite feasible, curing as a unit. Since fresh resin poured upon gel cures without visible dividing lines and bonds with complete security, numerous special effects obtainable by no other means can be worked out. Combinations of colours, transparent colour growing out of clear transparent, or opaque colours trapped within clear transparents, are examples. Another aspect is the merging into one unit of resins with different characteristics, such as rigid sections bound together by a flexible member. It is even possible to trim off flash and sprue in this stage, if care is used, to avoid subsequent machining.

The cure is completed in from 15 minutes to an hour, at temperatures seldom higher than 120 degrees C. There is almost no danger of over-cure; in fact, longer cures bring out the best qualities in many heat-resistant types. Once cured, the resin is considered to be thermoset. Polymerization is complete and final. The castings will, however, show surface softening, and this facilitates removal from moulds before cooling if the resin has been cured in the mould. Too sharp temperature changes should be avoided, but the period is in no way critical. If subsequent assembly demands, or post-insertion of inserts requires further curing, no damage to the casting will result.

Finished castings can be machined with the same precautions observed for cast phenolics. Holes may be drilled and tapped. Sawing and shaping is possible. With a good mould surface, buffing and polishing is seldom needed, but presents no problems. Parts may be put together using related resins as room-temperature adhesives, or returning to the oven for additional cure. Lacquers of styrene base have been found excellent for applying surface colour and gloss, bonding themselves by solvent action to become an actual part of the casting.

While polymerization is inhibited in some resins by copper, cobalt and other materials, a variety of inserts may be placed in the mould before pouring, anchored into position by resin shrinkage. Some attention should be paid to the size and positioning of such inserts to avoid overstrain, but the main consideration is adequate resistance to curing temperatures. This debars thermoplastics, which may distort and release solvents, but admits almost any other material, glass and metal serving especially well. Porous materials so used may be immersed in uncatalysed monomer to flood out air, and the absorbed resin joins the final reaction.

Many filling materials are usable to increase strength. Glass fibre and cloth, due to the close refractive index, become practically invisible; even in water-white transparent material they impart only a slight cloudiness. Metal powders which oxidize easily are discoloured by the peroxide catalysts, but do not otherwise affect the polymerization, except in the special instances mentioned. Non-fibrous mineral fillers are usable, but contribute little. Asbestos, wood fibre and pulp, macerated fabrics, even paper and cardboard, absorb the resin readily and improve opaque castings. Sheet materials —foil, cloth, paper and plastic films—can be used to support flexible types or give special effects in rigid.

Regarding dyes and pigments, while many of those used for styrene and methacrylate, or which are soluble in aromatics, give good results, they also may affect gel time. Most Oil Reds, for example, retard gellation for exaggerated

periods, while titanium or zinc-oxide pigments act as accelerators. There are no limits to the colour and pigmentation possible, but each application must be checked carefully to preserve schedules.

For moulds, even plaster serves very well if the surface is sealed, although the plaster must be well cured and volatiles driven off from coatings. Alginates, water-soluble cellulosics, polyvinyl alcohol, vinyl dispersions, and many heat-resistant varnishes have been used upon hydrates. Glass gives a beautiful surface and sheets of resin may be cast between pieces of glass, using vinyl-tubing gaskets, or open cavities may be sealed with glass plates, leaving a pouring sprue at one end. Low-melting alloys, such as Wood's or Rose metal, provide good results, and metal caught in undercuts may be melted off in boiling water without damage to castings. Phenolic and furane casting resins have been used, but their own slow cure does not fit well with the multiple-mould requirements.

The main difficulty with all rigid moulds derives from the shrinkage of polymerizing resins. If both the article to be cast and the cavity are designed so that this shrinkage releases the casting, all is well; but if there is any partition of detail upon which the curing resin can take hold, it will grip with enough strength to tear the mould apart or crack itself to pieces. In such cases the only answer is removal at the gel stage, or resort to flexible moulds.

With the exception of neoprene, which discolours water-white resins due to excess chlorine, a number of rubber and synthetic-rubber preparations may be used. Plastisols—vinyl-chloride dispersions in plasticizer similar to Welvic paste—have been found by far the best. Their chief handicap is their high cure of 175 degrees C., with resultant problems in preparing masters, and their progressive shrinkage if the resin is cured in the mould, since their critical temperature is usually about 80 degrees C. Quick and easy preparation by pouring over the master, permitting entrapped air to escape, and curing in a few minutes, has many advantages when castings are removed at gellation, and extremely sharp detail with good surfaces are obtainable. One mould will give as many as 100 impressions without apparent damage, even improving with use, and there is, naturally, no limit to the number of moulds which may be prepared. Backings of the same plastisols mixed with fillers give increased rigidity, and some success has been found using wire-gauze inserts. More conventional methods of plaster backings demand constant replacement, and do not appear satisfactory.

Experimental work has been done using throw-away moulds of cellulosic gels and high-temperature waxes (Acrawax C), which endure the cure temperature, but sufficient data is not yet available.

Separator coatings are advisable, both to simplify removal of castings and to preserve mould surfaces. Silicone-oil formulations perform well, preferably diluted with solvent and spray applied. The writer has obtained especially good results with a combination of catalyst and silicone oil in a mutual solvent thus applied. Some of the harder waxes (synthetic or natural) give good gloss, but require buffing after application; such coats will, however, serve for several successive castings without renewal. Methyl cellulose and polyvinyl alcohol have been used as a combination seal and separator, but do not give good surfaces. Conventional stearates and oils are out of the question, since they damage castings and cause sticking.

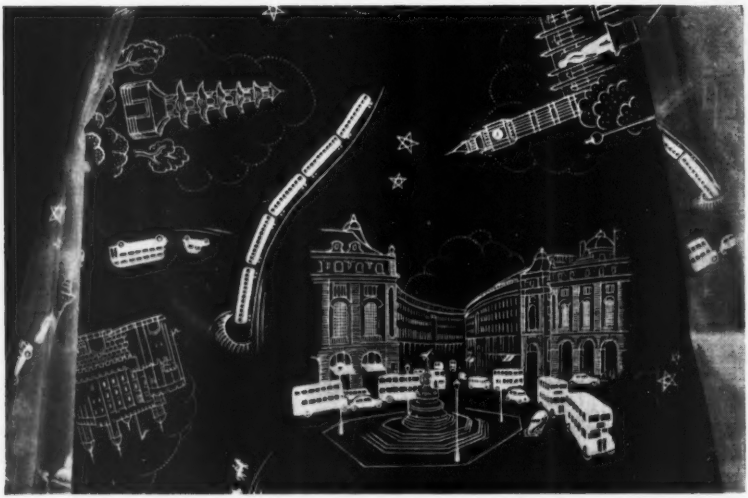
While development work continues, with the ultimate aim of a semi-automatic production method based upon these resins, the writer has at present standardized upon a specific casting technique for release to casting units. This involves the use of masters prepared from low-melting metal alloys from which moulds are prepared in a special plastisol, which

withstands curing temperatures of the polyesters without shrinking and cures well below other available types. A special separator coating has been tested and found satisfactory. By hand-pouring of multiple moulds and releasing at the gel stage—using catalyst-promoter-resin systems piloted in detail—a semi-handicraft method of production is possible, which competes very favourably with fabrication costs and, at the same time, makes possible types of items which cannot be injection- or compression-moulded.

The first items produced will be in the luxury field, such as jewellery, simulated tooled leather articles, lamps and the like, and in advertising signs and displays. It seems very likely that the next few years will see increasing numbers of such articles produced from polyesters.

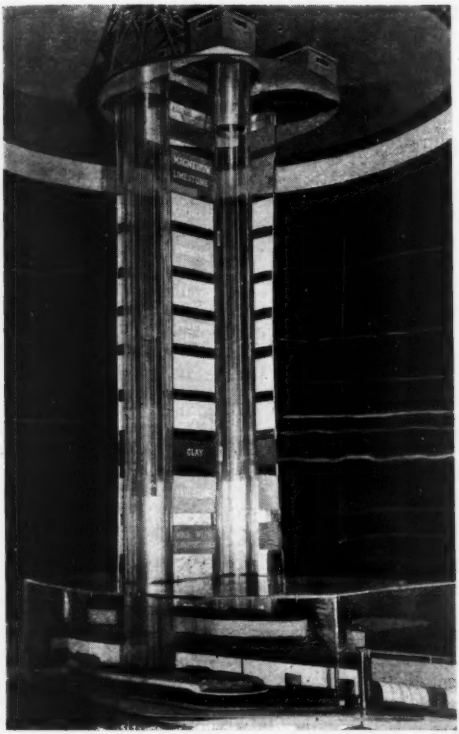
Limited production on this side, plus lack of stability in the resins, which range in shelf-life from six weeks to six months, makes availability in the United Kingdom dubious for some time. It is entirely feasible to prepare these resins as A and B components miscible before use, both remaining much more stable than the mixture, or even to supply the A (or alkyd) to be mixed with a B (or styrene-type constituent) obtained in the locality to which they are shipped. Removable inhibitors will also facilitate long-range shipments. But unless parallel types of resin are developed closer at hand, it may be another six months to a year before the United States production overflows into overseas markets.

With the present outlook it is extremely unlikely that these polyesters will ever provide direct competition for the quantity-production methods now familiar to injection and compression moulding. There is no question, however, that they do represent an enormous step forward in casting materials, and will easily find a place of their own.



NEW DESIGN IN P.V.C.—G.R.L. Plastics Ltd., London, E.C.2, have sent us a sample of their latest design in printed p.v.c. sheeting, for curtains and the like. We congratulate this company on choosing "London Town" as the motif, and on the excellence of the production. The sample sent is a white printing on a delicate warm translucent rose.

Two Demonstration Features at an Exhibition



Two interesting applications of plastic materials in the constructional sense as demonstration features were seen at an exhibition held in London by the Central Office of Information and styled "The Miner Comes to Town." The outer shell of the scaled model of a coal mine, here illustrated, was made by Thermo-Plastics Ltd., of Dunstable, using transparent acrylic sheeting. The dimensions, 16 ft. at full width of base by 8 ft. high, are larger than usually found. This shell, moreover, had to support its own weight in addition to that of the cages and driving mechanism. By using heavy-gauge "Perspex," and sheets of large size, it was possible to attain considerable rigidity and reduce the number of joints to a minimum. A special process of jointing still further assured the maximum strength possible. Apart from good visibility, the acrylic sheeting also provided good shock resistance and perfect electrical insulation, which are important criteria in any such material used for a working model. Attractive edge-lighting effects were obtained.

The versatility of light-density material in the form of "Dufaylite," a product of Dufay-Chromex Ltd., for constructing a large-scale demonstration map, is well illustrated by this example, showing the location of coal mines throughout England and Wales. The material is easily cut to the shape of the coastline, and is otherwise adaptable.

Plasticization of Thermoplastics with Special Reference to Stability

By E. E. Halls

PRACTICALLY all of the thermoplastic materials have a wide variety of uses in a range of different forms. The same basic material may be encountered as a sheet, tape or film, as a rod, tube or extruded section, as an actual article moulded from powder, as a thread, fibre, yarn or fabric, or as a lacquer or enamel that can be applied by orthodox paint-finishing means to give an applied coating or film. Again, within the same form, a variety of physical properties may be obtained, as evidenced by sheet ranging from hard and brittle to soft and flexible, tube varying from rigid to pliable, and so on. It should be observed that this almost unlimited selection is obtainable from a single plastic base, such as polyvinyl chloride or cellulose acetate.

Primarily it is the properties of the basic plastic that are being exploited. These properties may include one or more of such characteristics as chemical inertness, resistance to corrosives, mechanical strength, physical toughness, good resistance to heat or performance at low temperatures, specific electrical attributes, moisture resistance or impermeability, notable resistance to wear or abrasion, stability under exposure conditions that may include light, humidity and temperature fluctuations or even open-weather conditions. It may also be that the natural properties of the basic plastic can be improved by the inclusion of another agent; that is, improved in relation to a particular property or properties for a specific application. In such a case it is evident that a new variety of the basic material has been evolved with its own sphere of usefulness. Silica-loaded ebonite or hard rubber compared with ordinary ebonite serves as an example, the loaded compound having better resistance to heat and improved electrical-loss factor as compared with the ordinary ebonite. Woodflour-filled cellulose-acetate mouldings, having somewhat better resistance to plastic yield at elevated temperature and better shrinkage factor than straight cellulose-acetate mouldings, serve as a second illustration.

The basic plastic in itself is often unsuitable for producing the range of forms in which it is urgently required for solving real problems in service. Thus there is a real need to endeavour to take some action whereby the plastic can be modified in order to give the shape desired without loss of any of the characteristics that may be apt in the specific application. It is in this sense that plasticization enters the picture. Admittedly, there is no strict definition to the term nor limitation of the purpose that it serves. In consequence, there is some looseness of interpretation, and this may not matter seriously. There may also be much indifference concerning the plasticizer employed, the quantity used, the manner in which it is incorporated in the plastic, and its influence upon the basic properties of the plastic under varying service conditions that are likely to be encountered in the life of the article. These aspects certainly matter; they are of vital importance. A user may be in serious difficulties from premature failure, not merely from the loss of the material, but on account of the breakdown of a complete equipment in which the material has its rôle to fulfil. A supplier may bring his plastic material and, incidentally, that of others, into disrepute through lack of appreciation of the influence of the plasticizer upon properties that are of significance.

For the present purpose, plasticization

will be interpreted as the modification of the basic plastic material by the proper addition and incorporation of an addition agent, commonly termed "plasticizer," whereby the material becomes more amenable to fabrication processes of moulding, extrusion to shapes, calendering to sheets, and the like. The plasticizer is assumed to function as a lubricant, separating the long-chain molecules of the thermoplastic polymer, weakening the forces of attraction between adjacent molecules and allowing easier slip and movement under the influence of the compressional forces of moulding, extruding, etc. The primary rôle of the plasticizer is, therefore, to enable the shape to be made. It may, incidentally, improve the properties of the plastic or it may even be required to improve them in individual respects. But there is a lot more required of the plasticizer than its primary rôle and these subsidiary property factors. Briefly, the plasticizer must allow itself to be incorporated efficiently with the plastic and it must remain incorporated under all conditions thereafter.

Standard Specifications

It is probably true to state that rarely does a user of thermoplastics appreciate the difficulties encountered by the manufacturer in achieving plasticization, and certainly many manufacturers do not appreciate what happens to the plasticizer under service conditions!

In the case of the thermosetting phenolic-aldehyde-type resins, grades and nomenclature are fairly well defined. In the case of moulded types, where specific desirable properties are acquired by judicious choice of filler, such as wood-flour, cotton flock, mineral material (mica or asbestos), the product is reasonably well defined and recognizable. A standard specification for quality, in fact, exists (B.S.S. 771) and a system for hall-marking has been introduced (B.S.S. 1253). A similar state of affairs is established for thermosetting resin boards with B.S.S. 1137 covering paper laminated types, B.S.S. 972 dealing with fabric laminated, and B.S.S. 1323 with boards for building purposes. Obviously, such specifications cannot cover all types, nor all aspects of a single type; further, they must be behind industry, because they can only follow progress since they represent industry's established capability. Nevertheless, they reflect the reaction of industry as a whole, producer and user, and are very sound in so far as they establish a quality standard.

No such counterpart exists for the thermoplastics, and probably the only standard specification existing in this country appertaining to this field is D.T.D. 315 for cellulose-acetate sheet. This only covers a limited range of properties for a restricted sphere of application. Moreover, as far as is known, there has been set up no machinery for dealing with the thermoplastics in this way. Granted, the subject is an exceedingly difficult one, yet no more so than for the thermosetting materials at the stage when this was tackled.

When a filler is added to a plastic, especially in the thermosetting series, the resultant material is recognized as a new one and identified accordingly. When a thermoplastic is plasticized it is still called the same thing with no identifying mark, except, perhaps, a supplier's grade number. Even when the latter exists initially, it is lost long before the material or article reaches its final destination. This is more serious than it may seem. The plasticizer may be an appreciable percentage of the product. From 20 per cent. to 50 per cent. by weight is quite common in cellulose acetate and in polyvinyl chloride; in some products, as much as 80 per cent. of plasticizer is incorporated. In short, it is often doubtful whether one is being supplied with the plastic ordered or with the plasticizer. If such plasticizer is properly and permanently compounded with the plastic, and if the material conforms to a standard of quality requirements to cover the proposed application, then the composition of the material ceases to be of

consequence in itself. However, in the absence of such standards, the position is very unsatisfactory.

Overall Quality

The uncertain overall quality of the thermoplastics which are available to-day is more enhanced than it was in pre-war days for several reasons. These mainly comprise the following:—

(1) Greater production of these materials.

(2) Greater application and wider field of usage of the finished products.

(3) Wider range of products with respect to versatility of properties required.

(4) Increased number of plastic manufacturers.

(5) Increased number of plastic users.

(6) Increased range of materials commercially available for use as plasticizers.

War conditions are in no way responsible for this condition of unreliability; in fact, in pre-war days it existed in the same way, but was not so generally realized on account of the fewer plastic types applied to a smaller sphere of usage.

It is considered that the plasticizer, its type, quantity and efficiency of incorporation, imposes a material influence upon the stability of the product, the word stability being employed in its widest sense. It is not overlooked that other factors, too, have some bearing upon stability, but for the present attention will be confined to the rôle of the plasticizer. The question is one that probably affects all users of the thermoplastics, and it is not something that requires consideration only by individual consumers. Electrical applications, packaging, building materials, household furnishings, clothing, toys, decorative articles; all these are influenced in one sense or another.

In the present article it is proposed to present some brief notes upon the rôle of the plasticizer, with views upon properties it should, or should not, exhibit; also to give an account of some American work deemed fundamental and sound, and illustrative of the attention afforded to the point in that country; to exemplify the statements made by means of laboratory data on various plastics from a variety of sources, and to express some views and suggestions for standards of performance.

It has to be appreciated that ideals are unobtainable and that it is necessary to exploit the best commercially obtainable. This is an acceptable state of affairs, but, lest the foregoing be misread as a one-sided view of thermoplastics, it is asserted that irreparable damage can result to the plastics industry by indiscriminate application of materials without full knowledge of their limitations as well as their merits.

The thermoplastics referred to will mainly be cellulose acetate and polyvinyl chloride. Attention is also called at this stage to the excellent exposition on the subject by Dr. H. Barron, which was published in "Plastics," October, 1943 (pp. 449-459), under the title "Plasticizers and Their Application."

Rôle of the Plasticizer

The functions of the plasticizer may broadly be regarded as those of rendering the basic plastic manipulable through fabrication processes, of enabling the desirable properties of this basic-plastic resinous material to be exploited without depreciating them, and of ensuring that the quality characteristics initially induced are maintained through the service life of the material. As the plasticizer in most cases has to create improved properties of extrudability, rolling or drawing to thin gauges, mouldability and ductility of film, it will generally be associated with improved flexibility; increased softness must almost inevitably be allied to this. According to the specific application, the degree of change imparted in these directions by the plasticizer must be controlled to within the limits acceptable in this application. Such control can be exercised within a reasonably narrow margin by choice of plasticizer (which may be a single compound or a mixture of two or

more), quantity of plasticizer and mode of incorporation.

The inclusion of a plasticizer must not cause any depreciation with retention of "initial properties." This feature needs to be considered apart from any modification to the properties of the material plasticized. This modification can easily be assessed by measuring the characteristics of the plasticized product and determining whether they are within the limits desired. If it is practicable, any adjustment can be made at that stage by adjusting the three control features enumerated above to produce either the exact requirements or the nearest practicable to them. To assure that the product is a stable one under service conditions over an extended period of time can be determined only by field trials or by tests applied before, during and after artificial ageing tests designed to simulate the conditions encountered in service. The formulation of a suitable product can be assisted and expedited by a sound prior knowledge of the physical and chemical properties of the plasticizer.

The service conditions will, naturally, vary widely with each type of application, with respect to atmospheric conditions and variations in them, to exposure temperature which may be influenced by the operating heat of the unit with which the plastic is associated, and to mechanical conditions of vibration, shock, and the like. Therefore, although basic methods of assessment may be devised, adjustment of conditions within the test method must be possible to suit the needs with relation to specific service applications.

Stability of Dimensions

Stability of dimensions is probably important in the majority of cases. It is certainly so with flexible plastics for domestic applications, such as curtain furnishings, clothing, and the like, and for most packaging applications. It is in all "window" applications; that is, where transparent plastic-sheet material is fitted in a frame the material must "stay put" within reasonable limits that can be allowed for by "free" fitting, with no signs of buckling or of shrinkage and falling out of the frame. It is important in most electrical applications, as otherwise one or more of a number of faults may develop, either directly or indirectly, e.g., distortion, splitting, extenuation, with resultant impoverished electric strength.

Stability with respect to a number of other properties must be regarded in some individual circumstances. Thus, a material used for its moisture-proofing properties must retain its initial level of water and moisture-proofness. The same applies to strength characteristics and to electrical qualities. In some cases it can appertain to resistance to heat, stability to light and degree of permanence to chemicals. In all these conditions it may not always be possible to achieve stability in its full sense, and when this is the case it is most important that the degree of stability or possible drift with respect to the particular property should be known.

Plasticization can sometimes be achieved not by including an agent that merely serves as a physical softener, but by polymerization conditions. The most important to mention under this heading is copolymerization, in which two different materials are polymerized in an intimately mixed condition, with or without some chemical union between the two. The stability of such a copolymer is dependent upon those of the two individual polymers, or of the copolymer if union between them occurs, rather than upon the physical retention of an admixed softener. The p.v.c. copolymers, such as polyvinyl chloride/acetate copolymer or polyvinyl chloride/crotonate, exemplify this point. Polymerization conditions to influence the molecular weight of the polymer can influence flexibility and reduction of brittleness, e.g., in polystyrene and polythene. Cross-linking in polymerization (e.g., polystyrene) can modify properties in this sense. In all such cases stability is a function of the basic material and is not complicated by added plasticizers. It may be that modifi-

cation along these lines will prove to be the most satisfactory, and perhaps the only satisfactory, way of inducing ductility, the requisite degree of plasticity, or softness, and, at the same time, procure stability in all relevent respects.

Plasticizing in the more commonly recognized sense means incorporating an organic compound, which may be a high-boiling liquid or a low-melting-point solid. In the ideal case the resultant mixture must be homogeneous, so that the plasticizer must be easily compatible and yield a uniform solution with the plastic. This condition may be achieved in some cases, but more commonly, and closely approaching the ideal, the plasticizer and plastic material are not truly mutually soluble; the plasticizer will wet the plastic and, during the mechanical process of mixing, it becomes absorbed, perhaps forming a colloidal solution and not a true solution. This represents the most stable degree of plasticizing that can be achieved in this way.

If the degree of wetting by the plasticizer is small and the absorption is small, either the same degree of plasticization cannot be obtained or the excess over that absorbed can only be dispersed mechanically.

If the absorption of the plasticizer is nil, then only a mechanical mix or heterogeneous product can be obtained. In this case, physical separation can occur later if conditions favour it; i.e., sweating or evaporation is likely. A mixture of plasticizers may conceivably avoid this occurrence, the one easily compatible enabling the one that is immiscible to enter homogeneously.

The first factor to satisfy is thus compatibility; other factors follow logically. A material having a low vapour pressure and high boiling point is desirable. Chemically, it must be inert and non-corrosive. Hence, it must be free from acid, devoid of tendency to oxidize or hydrolyse under normal exposure conditions. It must be insoluble in water and non-water-absorbent.

For electrical plastics, the plasticizer must possess electrical properties in harmony with those of the plastic base itself. Attention must be given to power factor and permittivity or power loss.

For ultimate use in contact with oil or chemicals, attention must be given to the reaction, physical and chemical, with the particular materials that will be encountered in service.

Plasticizers (in practice, mostly liquids) are generally characterized by low volatility and high boiling point, but it must always be borne in mind that volatility, when properly dispersed in a plastic, may be quite different from that of the plasticizer by itself in bulk under otherwise similar conditions. If it forms a solution with the plastic, its volatility may be lowered; on the other hand, because the material is distributed over a larger area, it may be apparently higher. The fact remains that the application of plastics is often limited by instability that is traced, in many cases, to loss of plasticizer; in other cases, failures occur for the same reason. Plasticizer can sometimes be visually seen, " sweated " as an oily film on the surface of the plastic.

For short-period service or under conditions of no great functioning importance, this subject of plasticization is not a critical one. In other cases, the future will see it essential to know the degree and stability of plasticization, and perhaps to control the quantity and quality of plasticizer by means of the purchasing specification.

(To be continued).

Safeguards Against Dermatitis

Notes on the causes of dermatitis and the protection therefrom of personnel using synthetic resin adhesives are contained in Bulletin No. 57, issued by the Technical Service Department, Aero Research, Ltd., Duxford, Cambridge. The routine preventive measures outlined will be found effective wherever synthetic resin adhesives are in use. Experience has shown that certain individuals have a tendency to contract dermatitis more readily than others, and this is a factor which has to be taken into close consideration.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

"Cock-eyed World"

Sir,—We had never thought that our letter dealing with an eventual export of combs to England from Denmark would have excited you so much that you grasped the pen and wrote "Cock-eyed World." But, in a way we understand you. Naturally, one does not like to have goods entering one's country when you yourselves can manufacture the goods of a like quality and thus cover the demand.

In just the same situation we found ourselves last year, when British-made combs were imported to Denmark in huge quantities at prices for about 6-8 Danish kroner per dozen, whereas combs manufactured in Danish factories did not cost more than from 2½-4½ Danish kroner per dozen. This we thought a lunatic policy, as our combs were of the same good quality as the English ones, and our factory alone could cover the demand for combs in Denmark.

You doubt whether the prices for our combs can truly compete with British-made combs in England. We do not know the height of the operators' wages in the moulding factories in your country, but with regard to the materials, cellulose acetate we buy in America for about 46 cents per lb. f.a.s. New York, whereas the same material costs in England about 8s. 3d. per kilo f.o.b. London. You will see a very marked difference in these two prices.

For your inspection, we enclose a comb made by us. The export price is 36s. per gross f.o.b. Copenhagen, which has proved to be a reasonable price as orders at this price have been received from many countries.

You must not forget that the plastics industry here in Denmark has grown enormously during the past few years. You seem to forget that Denmark's development in this technical production has also been of a great advantage to England. You cannot want to increase your export under the motto "Export or die," at the same time being annoyed by the development in the countries to which you have sent your goods, a development which has greatly been caused by the purchases from England.

NORDISK KAMFABRIK A/S.
Vordingborg,
Denmark.

[EDITOR'S NOTE: We are glad to publish this letter, which appears a good retort to our fulminations in the August issue (p. 398), and tells us we cannot have our cake and eat it. Our own reply is that the present condition of this country is due to a war which affected our capacity far more than most, and that much of it is employed in putting the world straight. The most interesting point is that Denmark can sell combs at a lower cost than we do. This is also an accusation of excessive British prices and a support of our contention that we are living in a cock-eyed world.]

Luminous Plastic Sheet

Sir,—Could you give me the name and address of manufacturers of luminous plastic sheet? The only samples of this material I have seen, which were about 0.010-in. thick, appeared to be cellulose-acetate, the luminous material being sprayed on the surface in one case, but incorporated in the material in the other case. These samples were intended to be placed behind the glasses of A.R.P. torches used in the blackout.

Cambridge. GEORGE A. BAGULEY.

[EDITOR'S NOTE: See our remarks, October issue, p. 547. The most likely concerns who would know whether such sheet is available now are B.X. Plastics, Ltd., British Celanese, Ltd., Erinoid, Ltd., and M. and B. Plastics, Ltd.]

Spraying Polythene

Sir,—We should like to comment on the statement on page 371 of the July issue of "Plastics," wherein it is said that polythene "cannot be made to adhere to metal surfaces." This is in direct conflict with our experience, for we have not found any serious difficulty in obtaining perfect adhesion between polythene and cast iron, steel, aluminium and light alloys, including magnesium elektron. We would agree that preparation of the surface of the metal is important, but that being conceded, our major difficulty is not adhesion but the difficulty in stripping polythene once we have sprayed it on to metal. In our process no solvent is used, the polythene in powder form being sprayed direct on to the metal by means of the Schori flame spraying pistol.

SCHORI METALLISING PROCESS, LTD.
London, N.W.10.

[EDITOR'S NOTE: On re-reading the article in question, it is apparent that the author referred to impossibility of using adhesives. Obviously, however, as we pointed out in our October issue, spraying polythene solves many problems.]

Casting Compositions

Sir,—We have to make a small casting of a rather fragile model which is probably of carbonaceous nature. In "English Mechanics," 1935, we find that a Swiss firm, Apotela, Ltd., 24 Ottikerstr., Zurich, 6, marketed materials developed by Dr. A. Poller, of Vienna. The compositions recommended were Negocoll, which is an elastic hydrocolloidal substance, and casting compositions called Hominit and Celerit. Can you tell us if there are any British equivalents on sale in this country?

INDUSTRIAL DISTRIBUTORS (1946), LTD.
32-34 Holborn Viaduct, E.C.1.

[EDITOR'S NOTE: In our July, 1937, issue, p. 64-65, we published an article on the subject of the above casting compositions which were stated to be of a Bentonite-type base mixed with synthetic resin and wax. The resulting castings were extremely accurate, showing such great detail that it was stated the material was being used in criminology. Luric, Ltd., in London, handled the rights in this country. We note that the address of this concern is the same as that of Pytram, Ltd., Dunbar Road, New Malden, Surrey, who are well-known model makers.]

"Araldite" Resin

Sir,—Reference is made in the October issue of "Plastics" (page 523) to Araldite, a bonding material developed by Ciba, Ltd.

Araldite has given excellent results in bonding metals and in the joining of metals to glass, glass to glass, porcelain to metals, china to china, metals to plastics, and plastics to plastics. No pressure is required for bonding, beyond the amount necessary to keep the surfaces in contact.

As sales agents for the United Kingdom, we shall be glad to provide any of your readers who may be interested with full details.

AERO RESEARCH, LTD.
Duxford, Cambridge.

Engrained P.V.C.

Sir,—We would be obliged to learn of a source of supply for engrained P.V.C. sheeting, of patterns simulating leather. We enclose sample of the type in which we are interested.

Cambridge. PYE, LTD.

[EDITOR'S NOTE: B.X. Plastics, Ltd., Greenwich Leathercloth Co., Ltd., Erinoid, Ltd., B. Lipman and Co., Rubber Improvement, Ltd., P. B. Cow and Co., Ltd.]

Advertising Signs

Sir,—You will, no doubt, be interested to learn about a "Perspex" sign that occupied a prominent place on the stand of our client, The Erie Resistor Co., at Radiolympia. We believe this is the largest "Perspex" construction ever made for such a purpose. It is 4 ft. in diameter, 6 ins. deep, and is constructed from material 1 in. thick, edge-lit, with changing colours. The sign was made by Plexi Products, Ltd., of Burlington Road, Fulham. PHILLIPS ADVERTISING, LTD.
London, W.2.

"Putting Our House in Order"

Sir,—What is wrong with the plastics industry? Why is there so much which hinders and delays normal progressive development? The whole aspect resembles a complicated jig-saw puzzle which will not come out right!

During the war, plastics made rapid strides when obliged to use resource, and great help was rendered to the National effort, despite improvized plant and substituted raw materials. In addition there were curtailments of experienced personnel, owing to enforced enrolments in the Forces and also the large number of experts loaned to Government Departments for advisory appointments. But all this did not halt progress.

To-day, nearly 2½ years after the cessation of hostilities, the plastics industry appears to have almost reached a standstill. It is true, of course, that there have been many contributory causes and quite a number of them can be blamed on the general economic situation. There are acute shortages of vital chemicals and basic materials. During the war some were readily available under Lease-Lend arrangements, but adequate steps were not taken in advance to make provision for their production here by the time the overseas supplies would certainly terminate, though no one could determine in advance precisely when this would come about. Much plant, tools, and machinery had tremendous tasks placed on them, and through wear and tear had become either obsolete or needed overhaul and renewal. This was the gap which no one had planned to bridge or had had the courage to anticipate!

It is true also that the end of the war left us with the much-detested controls to dole out commodities in order of calculated priority. This and the previously mentioned factors all combined to make things unpleasantly difficult, but they cannot be blamed for everything which has gone amiss.

Trade publications and other journals closely allied to them are devoting more and more space to plastics. Some firms rush into print to offer products which they advise inquirers are considerably oversold; others publish premature announcements.

Plant and machinery are widely offered. Quotations, specifications and brochures are provided in great profusion —but estimated delays in deliveries may be anything up to 2½ years, by which time the method might be out of date or discarded altogether. So worn-out equipment, with patched up renovation, must continue to ramble on doing the best job it can in the circumstances.

Deficient plant is one of the main excuses put forward when poor, imperfectly processed goods or finished articles reach the distributors for passing on to manufacturers of end products or for sale to the retailer. Colours and grades vary, often cannot be repeated, and flaws and blemishes occur. Much material is utterly spoilt yet goes into the market as first quality only to be frequently rejected or marked down as "seconds." Makers are most indignant when called upon to explain and they simply express regret that they cannot do better. Contracts are lightly regarded and overdue dispatches are delivered late with the expectancy that they will be readily accepted. Commitments not honoured are excused to raw material miscalculations, mechanical breakdowns, labour troubles and the like.

Trade associations collect lofty subscriptions, but do precious little to ease the situation. Technical committees deliberate on developments and suggested improvements. They circularize much information in great detail, which is never put into effect. Firms get together and talk about their troubles, but refrain from boosting their own successes for fear of being copied. Controls, self-imposed by bodies or groups, may be rendered ineffective without enforceable penalties. Agreements made in unison can be broken individually. Rubbishy goods and materials have to be tolerated, without being condemned or boycotted. So the game goes on!

Surely the time has arrived for the

plastics industry to put its house in order. There is a sad lack of co-ordination between manufacturers, converters, merchants and wholesalers towards the tastes of the general public, who, after all that is said and done, regulate the sales of any merchandise which is developed and offered. Some effective form of organization is therefore necessary to synchronize productive capacity with actual demand. This should commence at the beginning—at the initial stage of selecting the components which combine to produce the manufactured raw materials upon which craftsmen use their skill. These should be standardized to prescribed specifications thrashed out by experts as a guarantee of warranty and suitability, and then be given a hall-mark or be graded.

Since supply and demand are also co-related, production of materials has to be calculated in bulk according to the particular requirements of any major industry needing essential supplies so that there is no wasteful surplus margin which becomes a burden on the market. This would allow concentrated efforts to be devoted to the less important products needed as accessories. Due attention must be paid to the colour-scheme and qualities, and in this way much of the rubbish foisted upon the public would be eliminated and the "take it or leave it" attitude abandoned. In addition, such control would save the consumer from casual exploitation, which is at present one of the evils to be overcome. The industry would accordingly terminate many of the activities of the job merchants who take advantage of sub-standard productions and harm merchandise of repute and perfection.

Further, retail shops and stores and other vendors or users of materials or finished goods have to be provided with information concerning their merits and advantages—they must be educated to answer the questions which may be asked by the public and thus save much disappointment in instances where in total ignorance plastics are being misused.

All this is a tall order, but it challenges the best interests of the industry. To undertake such a task must involve a great deal of hard thinking on sound, progressive lines. Manufacturers, hand in hand with merchants, fabricators and retailers with the co-operation of consumers, would all mutually benefit. The industry which has achieved so much in a short time could then go forward to fresh triumphs by giving satisfaction with honest value and with the confidence of the people they seek to serve.

R. W. BENNETT, director,
B. Lipman (Plastics), Ltd.
London, N.1.

[EDITOR'S NOTE: Mr. Bennett, who we know has never lacked the courage of his convictions, has certainly let himself go. How much we agree with him regarding quality and the necessity for raising the standard, and the presence of badly designed, badly fabricated material! On the other hand, we cannot agree that the work of technical committees is altogether wasted. It is extremely difficult, if not impossible, under present conditions and in the face of the enormous demand, to carry out suggestions. Thus, for example, to satisfy the demand we may be forced to use phenolic compounds, which, before the war, would not be used for the best-quality resins. Similar difficulties run through each and every industry. Nevertheless, many of Mr. Bennett's grouses are warranted, and we are glad to ventilate them.]

Washers

Sir,—We are manufacturers of filling machines, and have to use washers on these machines.

We usually provide them in leather, as they have to be flexible, but in one instance the leather washers gave trouble, as they were attacked by the material which has to be handled by this machine.

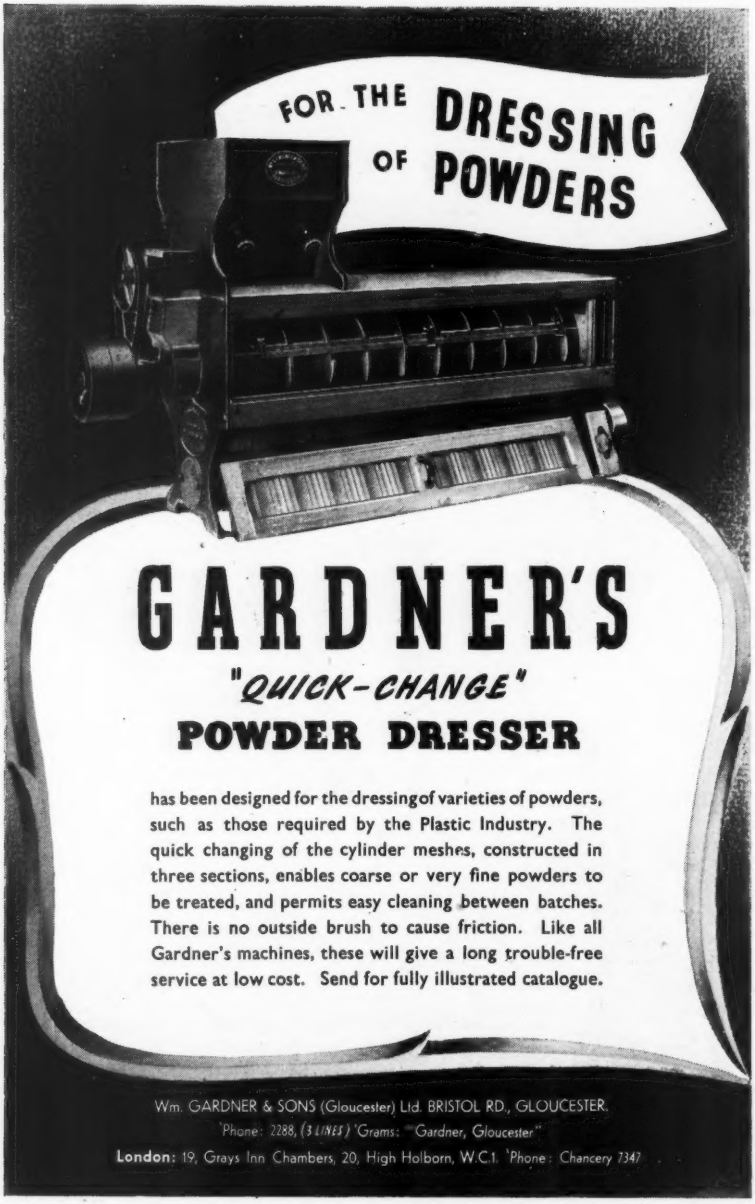
We have in mind to replace these washers by acid-resisting flexible plastic, and shall be very glad if you can advise us what kind of material should be chosen for this purpose, and if you can let us have the names of firms supplying such material. A.B.C., LTD.

London, N.1.

[EDITOR'S NOTE: We suggest polythene. Such a moulding is simple and could be carried out by any reputable moulder.]

Plastics from I.C.I. are favourites with the Lady of the House. She finds them versatile, gay and easy to clean. They save time in the kitchen and bother in the bathroom. They give grace to her boudoir, colour to her schemes, and a fillip to her parties. Plastics, in short, make light work and bright houses.

ICI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has been designed for the dressing of varieties of powders, such as those required by the Plastic Industry. The quick changing of the cylinder meshes, constructed in three sections, enables coarse or very fine powders to be treated, and permits easy cleaning between batches. There is no outside brush to cause friction. Like all Gardner's machines, these will give a long trouble-free service at low cost. Send for fully illustrated catalogue.
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Notes from British Plastics Federation

New Members.—The following have recently been elected to membership of the British Plastics Federation:—

SURFACE COATING RESIN SECTION OF PLASTICS MATERIAL MANUFACTURERS' GROUP

Howards and Sons, Ltd.
Plastanol, Ltd.

MOULDERS' GROUP

Grafton Aircraft Components, Ltd.
Pendry (Plastics), Ltd.
Plastic Moulding Co., Ltd.
Smart and Brown (Engineers), Ltd.

ENGINEERS' GROUP

Projectile and Engineering Co., Ltd.

The following have been elected to associate membership:—

Almex, Ltd.
Dohm, Ltd.
J. M. Steel and Co., Ltd.

Bowen (Cables and Plastics) Prize Fund.—At the last meeting of the Executive Committee of the Council a pleasing ceremony took place, when Mr. W. Bowen, chairman of Cables and Plastics, Ltd., presented the first Bowen (Cables and Plastics) prize to Mr. F. J. Lupton, of Fox and Offord, Ltd.

Exports.—The question of exports is receiving active consideration by the Federation, which is in close contact with Government Departments regarding export policy. It is doubtful if the position of the plastics industry as a key industry supplying other industries with essential components and finished articles can be too strongly emphasized. Not only does it supply essential components and finished articles for direct and indirect exports, but it also supplies essential equipment to industries on which the whole export drive is dependent.

As a result of information recently received by the Federation it may be stated that the percentage of finished articles and components going for export has been steadily rising; while it varies, in some cases it amounts even to 100 per cent.

Fabrication of P.V.C. Sheeting.—As a result of correspondence in the technical trade Press an informal meeting of manufacturers interested in the fabrication of p.v.c. sheeting was held at the offices of the Federation in September. The primary interest of the meeting was to consider what steps could be taken to assist this section of the industry in ensuring that high quality goods were supplied to the public. It was agreed that a new section of the Federation should be formed within the Fabricators' Group to cover these interests.

As a first step a report was made that those manufacturers concerned with the manufacture of p.v.c. sheeting were already engaged in developing a specification for this material. The fabricators of this material were not only interested in this information, but considered that that was an essential first step to securing from the suppliers material of reliable quality, which would enable them to make good quality articles for the public.

Information Bureau Service.—In a recent two months' period the Federation received and answered through its Information Bureau Service over 500 inquiries relating to a variety of matters concerning not only sources of supply of materials and products, but other miscellaneous inquiries regarding such items as purchase tax, customs duty and the like.

This Information Bureau Service of the Federation is at the service of the industry. Inquiries should be addressed direct to the British Plastics Federation, 47-48, Piccadilly, London, W.1.

Preheating by Radio Frequency.—A report, arising from an extra-mural contract granted by the Ministry of Supply towards the end of the war, on the preheating of moulding powders by radio frequency methods (containing, in addition, reports by member firms of the Federation giving results of practical experience) was published by the Federation in 1946. The restrictions imposed on the sale of this report have now been withdrawn, and it is available to the public, price 10s.

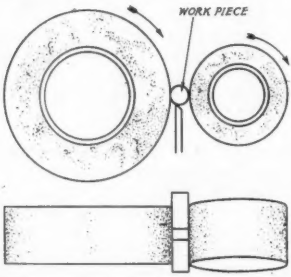
Phenolic Moulding Materials.—A special committee of the Moulding Powder Manufacturers' Section has been engaged for the past twelve months in undertaking a very thorough revision of B.S. 771 for phenolic moulding materials. This revision has now been completed and has been forwarded to the British Standards Institution, for that organization to take the necessary steps to arrange for publication. The last issue of the specification was in 1938, since when there has been considerable advance which necessitated a complete revision.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

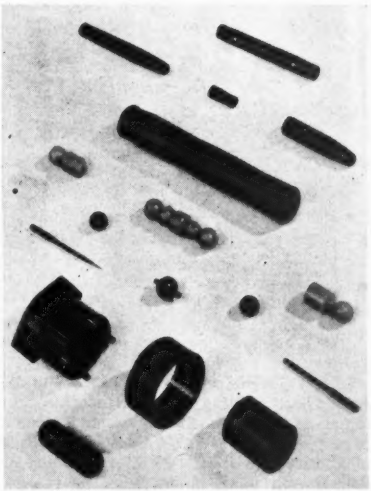
CENTRELESS GRINDING.—We have received from Arthur Scrivener, Ltd., of Tyburn Road, Birmingham, some notes upon the steadily growing importance of "centreless grinding" in the plastics industry. This subject has received but little attention in standard reference books dealing with the finishing of plastics, in spite of its importance in the production at low cost of fountain-pen components and like items shown in the accompanying illustration, although in the engineering industry generally "centreless grinding" has been an indispensable process for a couple of decades.

In principle the workpiece (whether a long tube or shorter cylindrical length) which has to be ground on the parallel outer diameter is passed between two wheels, supported on an angular workplate, during



which passage the large grinding wheel removes the stock, while the smaller control wheel serves to rotate the workpiece at the correct speed, and at the same time—aided by a slight inclination of this wheel relative to its axis—draws the piece through the machine. In the plastics industry the process is more widely known as "trapping."

As regards stock removal and accuracy, the requirements of the plastics industry are somewhat different from those of general engineering. In the latter the stock removal is only in the order of 0.005 to 0.010 in. per cut, and the normal passing-out test to which every Scrivener centreless machine has to conform is the production of work inside 0.0001 in. truly round, and within 0.0001 in. for parallelism the full width of the wheel.



In the plastics industry a much greater amount of stock removal is called for, this being up to 0.040 in. per cut, but, on the other hand, the final accuracy of the piece is usually not required to be to the same tight limits as in engineering work, tolerances of plus-minus 0.001 in. usually being adequate.

In the straight-through grinding of plastic rods of small diameter, a production of over 100 ft. per minute is obtainable on diameters up to $\frac{3}{8}$ in., decreasing to about 50 ft. per minute for $\frac{3}{4}$-in. material. In the field of laminated phenolics, it is also possible to produce accurately sized round rods from square-section strips cut from sheet in a single pass through the machine at rates of 4 to 10 ft. per minute. This material, which is so highly resistant to normal cutting tools that the life even of cemented-carbide tools is quite short, presents no difficulty whatever for the centreless grinding machine.

Among unusual possibilities of the centreless grinding process is the facility for producing cheaply and in very large quantities such work as round beads and knobs. Beads are usually required from 6 to 14 mm. diameter, and these can be produced from

extruded plastic tube, the grinding wheel being suitably formed and radiused to grind and part off a number of beads at each plunge stroke of the control head. The number of finished beads or knobs obtainable at each plunge-grinding movement would naturally be determined by the number of radii which could be formed in the width of the grinding wheel, but in regular production this would be anything from 5,000 per hour upwards.

GRINDING CARBIDE TOOLS.—A new grinding and lapping machine for shank-type carbide cutting tools, introduced by A. C. Wickman, Ltd., incorporates new rust-proof and anti-splash features desirable to both management and operators. It is a self-contained unit occupying overall floor space of 42 ins. by 34 ins., with two 8-in. wheels and tables set at a comfortable working height. The wheel covers, a special outer splash screen, and the tray are designed to prevent coolant from passing out of the machine. All vulnerable points are rust-proof, the clamp levers and other adjustable parts being cadmium-plated. Leaf springs replace the conventional slides for carrying the tool rests, thus providing a rustproof mechanism for adjusting the tables to compensate for wheel wear. The wheels are driven by a 2 h.p. reversible motor (2,910 r.p.m.), giving wheel speeds of 6,100 ft. per min. at the periphery.

MACHINE TOOL TRADES ASSOCIATION will stage an International Exhibition at Olympia, London, late in August, 1948. It will be called the Machine Tool and Engineering Exhibition, London, 1948. This will be the first exhibition of its kind to be held in London since the M.T.T.A. Exhibition at Olympia, 1934.

P. B. COW AND CO., LTD., have declared an interim ordinary dividend of 12½ per cent. on account of 1947.

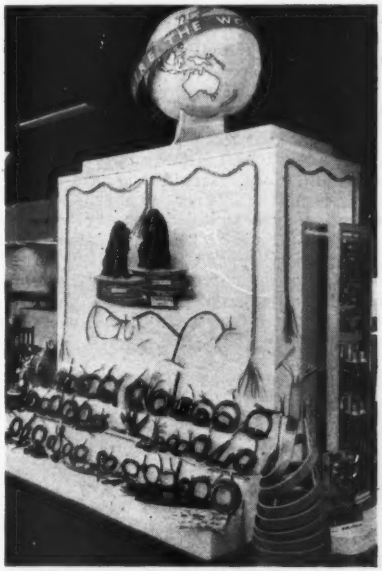
LACRINOID PRODUCTS, LTD.—In order to provide additional working capital, the directors have decided to offer to shareholders 200,000 new 2s. shares at 5s. each in the proportion of two for every 13 held on September 30. Each shareholder may apply for excess shares. The authorized capital of the company is £150,000, of which £130,000 has so far been issued.

MR. MAX KLEEMANN, deputy chairman and joint managing director of O. and M. Kleemann, Ltd., died at Welwyn Garden City, Herts, in October, at the age of 59.

PLASTIC EXPORTS.—Mr. S. C. Lewis, managing director of Rubber Improvements, Ltd., and Mr. J. A. Harvey, managing director of British Mouldex Rubber Co., Ltd., have left London for a tour of 12 European countries and North Africa to obtain orders for British plastics and rubber flooring.

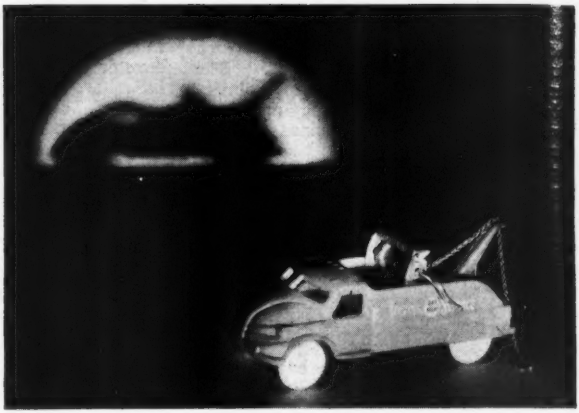
A. C. WICKMAN, LTD.—Upon his return from an extended tour of the United States, Mr. Allan Smith assumes charge of the Newcastle office, under Mr. J. Macgregor, of the Glasgow office. Mr. W. V. Hodgson, lately manager at the London office is now transferred to Coventry, to assume an executive sales appointment there; Mr. F. Ellis assumes the position of acting manager, London office.

PEGLERS, LTD., makers of steam valves and water fittings, announce that the new address of their London depot will be Prestex House, Marshalsea Road, London, S.E.1.



Stand of Duratube and Wire, Ltd., at "Radiolympia," showing a comprehensive range of p.v.c. insulated Durawire and Duracable. On extreme right, a sound-recording rack for M.S.S. Recording Co., Ltd., wired throughout with Durawire and embodying Microflex-Duratube for insulation purposes.

New Productions from the Moulding Shops



Toy Repair Lorry

Mr. Islyn Thomas, of the Thomas Manufacturing Corporation, of Newark, New Jersey, has sent us this delightful toy breakdown lorry, which is complete with workable crane and chain. The toy has been injection moulded in cellulose acetate, and has fascinated the discriminating young of the U.S.A.

Face-powder Box

In France, we recently picked up the face-powder box which is the subject of one of our illustrations. Moulded in urea-formaldehyde, this container seems to us of exceptionally beautiful design, more especially because of the "deep-cut" top. The floral design appears extremely solid and much more attractive than the usual shallow mouldings. The designer has therefore fully justified the small increased mould cost which this entails.

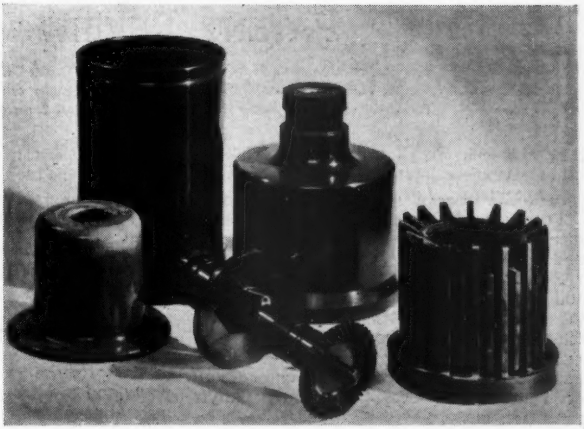
Cigarette Package

Another new and interesting job from France is a cigarette package holder. The thin paper container is always a nuisance; it is easily crushed and tears even more easily. Cigarettes thus get broken, or are decanted into the pocket. The strong rigid transparent container shown below is stated to be of polyvinyl acetate.

Rayon-spinning Accessories

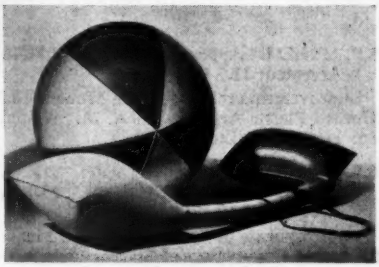
Mouldings in phenolic material play important rôles in the textile industry. The group of mouldings illustrated was designed and produced for Courtaulds, Ltd., and was included in the Bakelite display at the 1947 British Industries Fair. The central moulding to be seen in our illustration is a

spinning pot, as used in rayon production. The rayon yarn is wound to form a "cake" on the inside of the pot, and in service the moulding is subject to contact with acids and humid conditions of atmosphere. This is primarily the reason for the adoption of Bakelite mouldings for all these components; of all their properties, probably chemical resistance is the one of outstanding importance governing their adoption. On the right is seen an improved form of spinning reel.



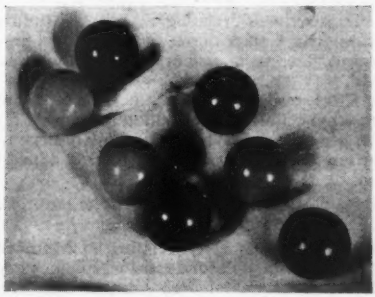
Beach Playthings

A particularly severe test of the quality of p.v.c. material, and even more concerning the efficiency of the high-frequency welding process which is employed in fabrication, has been forthcoming from the beach ball and water wings which we illustrate. Both articles, by Plysu Products, Ltd., of Egham, are of vinyl sheet made from "Vybak" compounds supplied by the Vinylite Unit of Bakelite, Ltd. The vinyl sheet was calendered by Olympic Industries, Ltd., of Enfield.



Playing Marbles

New plastic toys for children in Australia include safety scissors, marbles made from synthetic resin, and units for the old-fashioned game of "jacks," formerly played with knucklebones. The plastic marbles are an Australian invention and were evolved as a result of the shortage caused by the difficulty in importing playing marbles from Germany, Japan and the United States. They are said to be much better in quality than the old "bottlies," are a little lighter in weight than the ordinary marble, and are produced in yellow, green, red and white. The manufacturers are Bernard's Toys and Novelties, 213 Elizabeth Street, Melbourne.



Plastics at Birmingham

A three-day exhibition devoted to plastics was held at the Council House during October. Birmingham has a long association with the plastics industry, and there are many important moulding and fabricating concerns in the city and its immediate suburbs. The exhibition was educational and intended for the general public. It was concerned with the various types of plastics materials available and their applications in engineering and industry generally, and included aircraft components.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 590,055. Application date: 11.4.45. Convention date (U.S.A.): 12.4.44. Accepted: 7.7.47.

Polymers and Interpolymers and Films therefrom. To: E. I. du Pont de Nemours and Co.

Relates to the production of supported and unsupported polyethylene films containing minor proportions of glycerine and esters. Glycerides quoted: Palmoil, coconut oil, linseed oil; esters mentioned; undecyl stearate, octadecandiol, monolaurate, octyl arachidate, decyl eicosanate, lauryl palmitate, etc.

B.P. 590,073. Application date: 13.10.44. Accepted: 8.7.47.

Improvements in and relating to Moulding Strips and like Elongated Members intended to be held in Operative Position by Means of Clips. H. H. Murray.

B.P. 590,130. Application date: 13.4.45. Convention date (U.S.A.): 15.4.44. Accepted: 9.7.47.

Improvements relating to Ethyl Cellulose Moulding Compositions and Articles produced therefrom. To: British Celanese, Ltd.

Shock resistant water bottle moulded from an ethyl cellulose composition containing 15-20 per cent. of a plasticized mixture comprising butyl stearate and a refined mineral oil.

B.P. 590,167. Application date: 10.1.44. Accepted: 10.7.47.

Improvements in or relating to Moulded Products with Reinforcement of Filamentary Material. J. Allan. To: British Celanese, Ltd.

Shock resistant moulded product reinforced with randomly arranged filaments of regenerated cellulose of a tenacity of at least 3 grams per denier.

B.P. 590,174. Application date: 18.5.44. Convention date (U.S.A.): 19.5.43. Accepted: 10.7.47.

Improvements in Cups and like Articles and their Production. To: British Celanese, Ltd.

Production of cups from a cellulose ether or ester film-forming material by attaching a tube of sheet material in order to close one end of the tube, cutting off the tube with the adhering closure and forming the cup or container.

B.P. 590,191. Application date: 13.11.44. Accepted: 10.7.47.

Polymerization of Unsaturated Organic Compounds. M. A. Yonker. To: E. I. du Pont de Nemours and Co.

Polymerization of 2-chloro-1:3-Butadiene in the presence of a water-soluble persulphate and a water-soluble ferricyanide in an inert atmosphere.

B.P. 590,192. Application date: 17.11.44. Accepted: 10.7.47.

A Communication from the Standard Oil Development Co. Improvements in or relating to Low Temperature Polymers of Olefinic Materials.

Plasticization of a copolymer containing a major proportion of isobutylene and a minor proportion of a diolefin by incorporating .05-12 per cent. by weight of an aryl mercaptan (alpha naphtyl mercaptan, beta naphtyl mercaptan, xylyl mercaptan).

B.P. 590,205. Application date: 10.1.44. (Divided out of No. 590,167.) Accepted: 10.7.47.

Improvements relating to Synthetic Resin Laminates. J. Allan. To: British Celanese, Ltd.

B.P. 590,224. Application date: 13.11.44. Accepted: 11.7.47.

Improvements relating to the Moulding of Mottled Plastic Articles. H. A. M. Winter. To: Hornflowa, Ltd.

B.P. 590,247. Application date: 11.4.45. Convention date (U.S.A.): 13.4.44. Accepted: 11.7.47.

Improvements in or relating to the Manufacture of Copolymers of Styrene and Acrylonitrile. To: Bakelite, Ltd.

Manufacture of copolymers of Styrene and Acrylonitrile having higher heat-distortion values and also much higher flexural and tensile strengths than polystyrene by copolymerizing a mixture containing 20-37.5 per cent. acrylonitrile monomer and 62.5-80 per cent. of styrene.

B.P. 590,286. Application date: 19.3.45. Convention date (U.S.A.): 25.2.44. Accepted: 14.7.47.

Stabilized Compositions comprising chlorine-containing Polymers. To: Imperial Chemical Industries, Ltd.

Stabilization of polyvinyl chloride and copolymers of vinyl chloride and maleic and fumaric esters with minor amounts of an aliphatic mercapto alcohol (thiosorbitol).

B.P. 590,321. Application date: 9.7.43. Convention date (U.S.A.): 21.8.42. Accepted: 15.7.47.

Improved Process of Preparing Phenolic Resin Compositions and Product thereof. To: The Borden Company.

Refers to water soluble phenol-resorcinol formaldehyde condensation products suitable as glues, which can be made insoluble by heat or by the application of a catalyst.

B.P. 590,322. Application date: 12.7.43. Accepted: 15.7.47.

Improvements in or relating to the Production of Vinylidene Chloride Copolymers. J. J. P. Staudinger and D. Faulkner. To: The Distillers Co., Ltd.

Production of a vinylidene copolymer by subjecting a mixture of vinylidene chloride and isobutene in the liquid phase to the action of heat and/or actinic light in the presence of catalysts.

B.P. 590,324. Application date: 23.7.43. Accepted: 15.7.47.

A Process for the Manufacture of Vinyl Chloride. M. Kaufmann. To: Gross, Shearwood and Heald, Ltd.

Manufacture of vinylchloride by reacting ethylene dichloride at elevated temperatures (above 60 per cent. C.) with sufficient inorganic alkali to combine with one molecule of hydrogene chloride per molecule of ethylene dichloride in the presence of a monohydric, aliphatic or alicyclic alcohol containing at least four carbon atoms per molecule.

B.P. 590,339. Application date: 26.9.44. Convention date (U.S.A.): 27.9.43. Accepted: 15.7.47.

Plastic Rivet. To: Victory Manufacturing Co.

One-piece blind rivet made of nylon, cellulose acetate or cellulose butyrate, useful for uniting sheets of metal or plastics.

B.P. 590,381. Application date: 11.1.45. Convention date (U.S.A.): 11.1.44. Accepted: 16.7.47.

Catalysts Compositions. To: E. I. du Pont de Nemours and Co.

Catalysts for reacting monovinyl-acetylene and hydrogen fluoride in the vapour phase, consisting of mercury oxide and an alkaline earth metal salt which is unreactive with hydrogen fluoride and mercury oxide (calcium sulphate).

B.P. 590,388. Application date: 12.2.45. Accepted: 16.7.47.

An Improved Method and Means of Producing a Compounded Article by a Moulding Process. C. F. Styles.

B.P. 590,390. Application date: 12.3.45. Convention date (U.S.A.): 13.3.44. Accepted: 16.7.47.

Polymers and Interpolymers of Dichlorodifluoroethylene. To: Imperial Chemical Industries, Ltd.

B.P. 590,398. Application date: 9.4.45. Accepted: 16.7.47.

Improvements in or relating to Coated Films. A communication from the Celanese Corp. of America.

Carboxylic-acid-ester film of cellulose or cellulose ether film with a water resistant, heat sealable coating consisting of polystyrene, paraffin wax, gum dammar or hydrogenated methyl abietate and alpha-methyl-para-methyl styrene in liquid form.

B.P 590,404. Application date: 20.4.45. Convention date (U.S.A.): 22.4.44. Accepted: 16.7.47.

Improved Compositions Containing Polyvinyl Halide Resins. To: Imperial Chemical Industries, Ltd.

Process for manufacturing vinylhalide compositions ranging from thin liquids to heavy pastes, useful for coating fabrics, wood, metals, etc., by mixing together an aqueous dispersion containing 15-55 per cent. of a vinylhalide or a copolymer thereof (polyvinylchloride or a vinylchloride-dialkyl fumarate copolymer) and not less than 25 per cent. of a substantially water-immiscible, volatile organic liquid in which the resin is insoluble but which is capable of swelling it. (Chlorobenzene, Trichlorethylene, Xylene, etc.) The mixture is then agitated to obtain a water-in-oil type emulsion.

B.P. 590,417. Application date: 5.7.45. Accepted: 17.7.47.

New Process for the Manufacture of Highly Polymeric Linear Esters of Terephthalic Acid. J. G. Cook. To: Imperial Chemical Industries.

Production of highly polymeric linear esters from terephthalic acid or esters by using a diester of a glycol with a low mole-

cular weight of mono-carboxylic acid in place of a glycol (e.g., ethylene glycol diacetate).

B.P. 590,490. Application date: 13.11.44. Convention date (U.S.A.): 10.11.43. Accepted: 18.7.47.

Production of Alkyd Resins. D. E. Adelson and H. F. Gray, Junr. To: Shell Development Co.

Production of alkyd resins by reacting polymers of allyl type esters or polymers of allyl type acetals or polyallyl type alcohols (polyallyl alcohol) with a poly-carboxylic acid or a hybride in the presence of a modifier.

B.P. 590,508. Application date: 29.9.44. Accepted: 21.7.47.

Method of Applying Paints. C. F. Lumb. To: Schori Metallising Process, Ltd.

B.P. 590,511. Application date: 22.12.44. Accepted: 22.7.47.

Improvements in and relating to a Process for Reacting Olefins with Formaldehyde. C. H. Hamblet and A. McAlevy. To: E. I. Du Pont de Nemours and Co.

B.P. 590,590. Application date: 10.5.43. Convention date (U.S.A.): 5.5.42. Accepted: 23.7.47.

Improvements in or relating to Styrene Fractionation. To: The Lumus Company.

B.P. 590,595. Application date: 14.3.44. Accepted: 23.7.47.

Improved Process and Apparatus for the Polymerization of Iso-Olefins. Communication from the Standard Oil Development Co.

Low temperature polymerization process for mixtures containing isobutylene and isoprene, piperylene or dimethyl-butadiene.

B.P. 590,596. Application date: 25.4.44. Accepted: 23.7.47.

Improvements in or relating to the Moulding of Thermoplastic Sheet Material. G. W. Borkland.

Method of making cupped formations of cellulose acetate, ethyl cellulose, acrylic resins and the like by softening the sheets by application of heat and subsequent forming in appropriate dies.

B.P. 590,616. Application date: 23.11.44. Accepted: 23.7.47.

Improved Process and Apparatus for the Polymerization of Olefine Hydrocarbons.

Communication from the Standard Oil Development Company.

Low temperature polymerization of isobutylene-butadiene mixtures in the presence of Friedel Crafts catalysts.

B.P. 590,622. Application date: 12.1.45. Convention date (U.S.A.): 21.1.44. Accepted: 23.7.47.

Improved Process of Preparing Resinous Reaction Products from Polyhydroxy-Benzenes and Formaldehyde. To: Westinghouse Electric International Company.

B.P. 590,654. Application date: 27.9.44. Convention date (U.S.A.): 27.9.43. Accepted: 24.7.47.

Improvements in and relating to Methods of Producing Organo-silicon Compounds. To: The British Thomson-Houston Co., Ltd.

Production of Organo-silicon halides from finely divided silicon and hydrocarbon halides.

B.P. 590,680. Application date: 17.3.43. Convention date (U.S.A.): 25.3.42. Accepted: 25.7.47.

Improvements in and relating to Coating Compositions. To: The British Thomson-Houston Co., Ltd.

Coating composition comprising a soluble fusible polymer of a diallyl ester of a dicarboxylic acid (diallyl phthalate) and a solvent and polymerization inhibitor (allyl acetate or methallyl acetate).

B.P. 590,684. Application date: 21.4.44 and 1.3.45. Accepted: 25.7.47.

Improvements in the Production of Phenolic Condensation Products and Treatment of Materials therewith. J. T. Marsh and J. Norbury.

B.P. 590,689. Application date: 26.6.44. Convention date (U.S.A.): 26.6.43. Accepted: 25.7.47.

Improvements in or relating to the Production of Extruded Shapes from Organic Thermoplastic Materials. To: E. I. Du Pont de Nemours and Co.

Forming of strainfree, thermally stable shapes from an organic thermoplastic material (methyl methacrylate) by extruding into an inert gas or liquid (air).

B.P. 590,698. Application date: 28.9.44. Convention date (U.S.A.): 1.10.43. Accepted: 25.7.47.

Process of Coating Hydrophilic Sheets or Films to render them Waterproof, and the Product produced. To: Sylvania Industrial Corp.

Coating of a film of regenerated cellulose with a top coating comprising polyvinylidene chloride or a copolymer thereof and a water-resisting intermediate coating consisting of a thermo-setting resin in the infusible state (urea formaldehyde resin).

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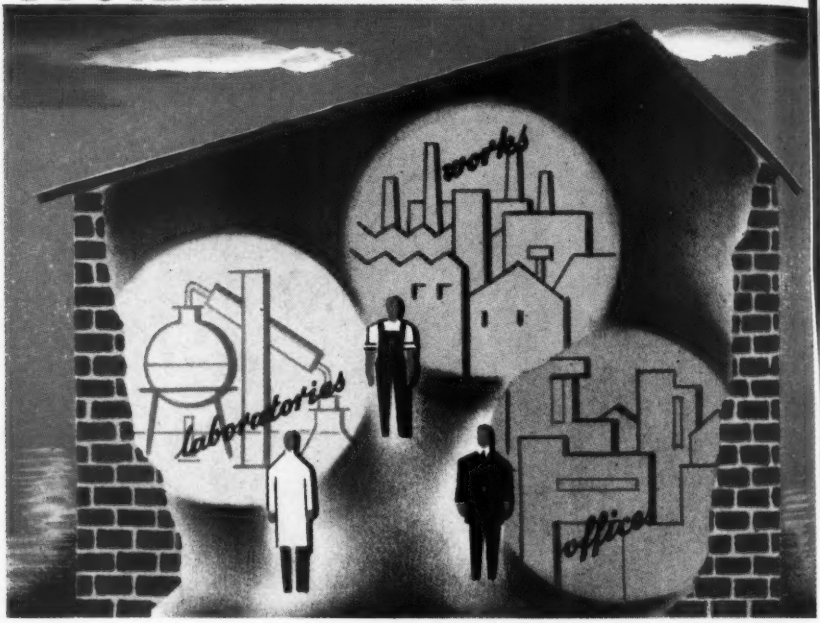

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B.P. 590,734. Application date: 23.1.45. Accepted: 28.7.47.

Improvements in or relating to a Process for the Production of Polyvinyl Chloride Compositions. J. J. P. Staudinger and D. Clevedon. To: The Distillers and Co., Ltd.

Stabilizing of polyvinyl chloride compositions by the addition of lead or tin dibutyl dialkoxides.

B.P. 590,736. Application date: 8.2.45. Convention date (U.S.A.): 16.2.44. Accepted: 28.7.47.

Improvements in or relating to Methods of Preparing Silicone Resins. To: The British Thomson-Houston Co., Ltd.

B.P. 590,761. Application date: 18.4.45. Convention date (U.S.A.): 15.9.44. Accepted: 28.7.47.

Improved Electronic Sewing Machine. N. V. Christenesen, H. J. Levesconte and A. M. Schweda. To: Union Special Machine and Co.

Pillar-type seam welder with roller electrodes.

B.P. 590,811. Application date: 28.3.45. Accepted : 29.7.47.

Improvements in the Production of Laminated Materials. R. A. Hudson and F. Langford. To : Imperial Chemical Industries, Ltd.

B.P. 590,816. Application date: 20.4.45. Convention date : (U.S.A.) 21.4.44. Accepted : 29.7.47.

Polymerization Products of Ethylene. To: E. I. Du Pont de Nemours and Co.

Polymerization of Ethylene in the presence of a catalyst containing positive halogen (a metal salt of an N-haloaryl sulphonamide, e.g., sodium-N-chloro-p-toluene sulphonamide).

B.P. 590,817. Application date: 20.4.45. Convention date : (U.S.A.) 20.4.44. Accepted : 29.7.47.

Polymers of Vinylidene Fluoride. To : E. I. Du Pont de Nemours and Co.

B.P. 590,831. Application date: 6.1.45. Accepted : 30.7.47.

Improvements in and relating to Plasticized Polyvinyl Compositions. H. Jones. To : The Geigy Colour Co., Ltd.

Plasticization of polyvinyl chloride and vinyl chloride copolymers with more than 10 per cent. by weight of di-2-ethylhexyl sebacate.

B.P. 590,930. Application date: 25.4.45. Accepted : 31.7.47.

Improvements in or relating to the Manufacture of Artificial Eyes. G. Haim and H. P. Zade.

Manufacture of artificial eyes from methyl methacrylate parts and coloured paper discs by means of high-frequency welding.

B.P. 590,955. Application date: 23.4.45. Accepted : 1.8.47.

Improvements relating to the Production of Keratin Meal for use in Moulding Operations. R. Neiger and V. Nachazel. To : Hornflowa, Ltd.

Preparation of keratin for moulding by crushing the raw material (hoofs, etc.) and subjecting it to grinding and sifting.

B.P. 590,999. Application date: 4.7.44. Accepted: 5.8.47.

Improvements in Synthetic Resinous Compositions. W. Kershaw and C. J. Whitelegg. To: Bleachers Association, Ltd.

Improvements in synthetic resinous compositions consisting of undissolved mixtures of polyvinyl chloride and tricresylphosphate, by incorporating a thermosetting resin which can be cured at 150 degrees C. (amino-formaldehyde). This composition is not tacky after curing and can be used for the coating of cotton fabrics.

B.P. 591,058. Application date: 27.10.44. Convention date (U.S.A.): 27.10.43. Accepted: 6.8.47.

Synthetic Rubber-like Materials. To: E. I. Du Pont de Nemours and Co.

Manufacture of cured rubber-like materials comprising the heat curing of a mixture containing a polymer or interpolymer of a monoethylenic compound, having one or more halogen, hydrocarbon or acyloxy substituent groups and one or more salt forming substituent groups (chlorinated polythene, chlorosulphonated polythene polyisobutylene, etc.) and litharge.

B.P. 591,085. Application date: 27.4.45. Accepted: 6.8.47.

Improvements relating to Injection Moulding Machines. S. Smith. To: E.M.B. Co., Ltd.

Patent of addition to B.P. No. 552,939. Relates to improved heat control to injection moulding machines.

B.P. 591,086. Application date: 27.4.45. Convention date (U.S.A.): 27.4.44. Accepted: 6.8.47.

Production of New Synthetic Rubber-like Materials. To: Imperial Chemical Industries, Ltd.

Relates to the manufacture of fluoroprene (2-fluoro-1, 3-butadiene).

The Microscopic Examination of Plastic Materials

VI.—Mouldings (Fillers)—(f) Fibrous Materials (Contd.)

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

WE have so far dealt with a few of the lesser-known monocot fibres and it seems expedient to deal with more common and widely known materials, by way of rounding off this section on monocots. For this purpose it is proposed to take, as our first example, one of the species of Agave fibres. There are many members in this group, but in general they are classed either as pita or sisal hemps. The former, which also goes under the names of Matamoros or Tampico hemp, may be obtained from Agave Americana, A. Mexicana Lam, A. vivipara L, and other species of the same genus. The centre of the pita industry, however, is in Mexico.

The material commonly known as sisal hemp includes fibres from a number of species of Agave produced mainly in Yucatan and the West Indies, where as many as seven different species are cultivated, but the true sisal hemp is yielded by Agave rigida, A. sisaliana, and A. elongata. In general, no sharp line of demarcation can be drawn between the pita and sisal hemps; there are, however, very definite and marked differences between the fine and coarse grades of commercial Agave fibre.

The sisal fibres are widely used in considerable quantities and are of some importance commercially, particularly as the waste products, from processes which convert the fibre into everyday articles, probably offer the most prolific source of raw materials for fillers in the whole field of commercial fibres.

It is generally thought that the fibre of Agave was used in ancient times by the Mexicans and Aztecs, as the existence of cloth woven from this fibre at that period seems to have been established beyond reasonable doubt. The name given to the material was "nequen," in connection with which it is of interest to note that the native Yucatan name of "lenequen" is applied to fabric and commercial sisal hemp at the present time.

True sisal hemp is mainly cultivated in Florida and is obtained from A. rigida, although this is not infrequently confused with a false Florida sisal obtained from Agave dicipiens, the latter being found wild along the Florida coast. Although these fibres may be deemed somewhat similar, the morphology of the plants shows a considerable difference, for the plant of A. dicipiens produces large leaf masses originating from the crown of a "foot stalk" and radiating in a starlike manner while A. rigida produces its leaves from ground level; likewise the colour of the leaves on the former are a bright green, contrasting vividly with the surrounding vegetation, while that of the latter is a dark olive green. The shape of the leaves of these two plants is also somewhat different, inasmuch as those of A. dicipiens are shorter and narrower than those of A. rigida, and usually somewhat curled, reminiscent of the Esparto grass leaf.

Regarding the fibres of these two plants, that of A. dicipiens is whiter, softer, and, being finer, is not so strong as the fibre from the cultivated plant, but in general the sisal fibres are stiffer and more harsh than the fine manila and jute fibres and it is for this reason that certain varieties rather more stiff than usual are used as a substitute for animal bristle

in cheap brush ware. There is one interesting point in connection with the production of sisal fibre which is worthy of mention, this being the utility of the leaf parenchyma which remains after the extraction of the fibro-vascular bundles; this is used as a very efficient soap substitute due to its possessing remarkable detergent properties.

The gross sisal fibre is an unmistakable entity; it varies from a straw colour to almost white and is, as a rule, very straight with a smooth surface, being 2½ to 4 ft. in length, it is naturally more harsh and a good deal less flexible than manila hemp. Nevertheless, its high tensile strength, second only to that of manila hemp, and abundant availability, makes it one of the most extensively used hard fibres. It is used for the manufacture of binder twine, general cordage, marine cordage and derrick ropes, although with regard to the latter uses it is not capable of withstanding the destructive action of sea water to the same extent as manila, and also from the mechanical point of view its lack of flexibility restricts its use for running tackle using pulleys of anything but quite large diameter.

For the purpose of studying the sisal fibres more closely, it is proposed to take Agave cantala as the first example, as this may be considered a fair representative of the species. The fibre is extracted from the leaves. It is therefore a true leaf fibre, and as with all the monocot plants is separated from the leaf with comparative ease, without the necessity of a lengthy retting process in water. In actual practice the extraction is done by machines which clean the fibre from the leaf and at the same time remove the soft parenchymatous tissues in running water. After extraction the fibre is sun-bleached for two or three days, during which time it is also dried; it is then ready to be baled for shipment.

Microscopic examination of these Agave fibres shows that they are all very similar in structure. Being of monocot origin they consist of almost entire vascular bundles and as such contain true

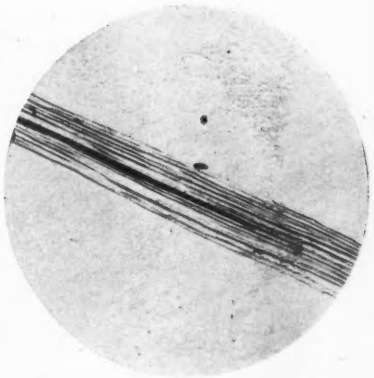

Fig. 229.—Agave cantala whole fibre. Mag. 26 diameters.

fibre cells in addition to the larger spiral vessels found in the bundles; also there are usually present a few parenchymatous cells from the surrounding soft tissues, but as a rule these fibres are so well extracted that this type of cell constitutes only a very small proportion of the whole and may therefore be ignored. The clean nature of this fibre is well shown in Fig. 229; here a whole fibre is seen at a magnification of 26 diameters, showing that there are no elements of an extraneous nature present. It may be argued that this is only a minute fragment of fibre and is therefore no criterion of the cleanliness of the material in general. This, of course, is true, but the statement is made on the normal appearance of the fibre to the naked eye, and it may be taken as a general rule that sisal fibre of good quality is one of the cleanest of technical fibres.

From this photomicrograph a good general idea is obtained of the grosser structure of the commercial fibre. From the presence of the long dark line in the middle of the fibre one may conclude that the elements in some cases possess a broad lumen, as this line indicates the presence of air in the fibre, although, due to its relatively large size and the possibility of the presence of large vessels, it is probable that this signifies the presence

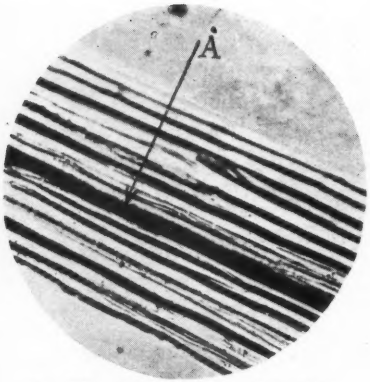

Fig. 230.—Agave cantala whole fibre, showing fitting of elements. Mag. 100 diameters.

of one such. The photomicrograph also shows indications of fibre elements with irregular outlines and a certain irregularity in the fitting together of the ends.

In view of these possibilities it becomes apparent that an examination at a somewhat more powerful magnification is necessary. Fig. 230 shows a portion of the same specimen at a magnification of 100 diameters. This view gives a much clearer picture of the structure of this fibre, largely confirming the conclusions previously arrived at. For example, the black line at A is clearly indicative of the very large bore of a thin-walled vessel, as may be expected if this latter were one of the large spiral vessels in a monocot vascular bundle. The walls of this vessel are seen to be thin, averaging about one-third of the diameter of the bore, and the external surface somewhat irregular. The phloem cells, or fibre elements proper, surrounding the large vessel are seen to possess thicker walls, although even among these there seems to be an indication of an irregular external surface here and there, and at the same time several ends of elements are distinguishable, from which an idea of the way they fit into one another is obtained.

Having examined the general morphology of the fibre and the relative arrangement of the elements, the next step is to examine the elements themselves when separated. This is quite easily accomplished by the usual alkaline treatment; when examined in this form they are seen to be fairly uniform in structure, although exhibiting the effects of growth strains somewhat strongly.

In Fig. 231 we see a few of the elements of Agave cantala at a magnification of 26 diameters. A general survey of this illustration shows these elements to be fairly uniform with regard to their external formation; in actual fact they vary from 1.5 to 4.0 mm. in length and from 20 to 32μ in diameter; thus the length-to-breadth ratio is about 100. Generally they are stiff in texture, due mainly to the thickness of the cell wall, although in places where the lumen is greater than that of the cell wall this latter is of necessity thinned to some considerable extent.

In spite of the fact that these elements show a degree of uniformity regarding size, the same cannot be said for their morphology; thus the element marked A is seen to be considerably distorted in shape, to the extent of having a series of constrictions along its length, giving it a wavy appearance in outline. The element marked B is also seen to be much distorted, but this takes the form of bends in the whole fibre rather than a

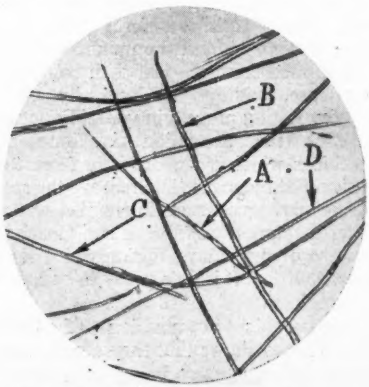

Fig. 231.—Agave cantala fibre elements (general). Mag. 26 diameters.

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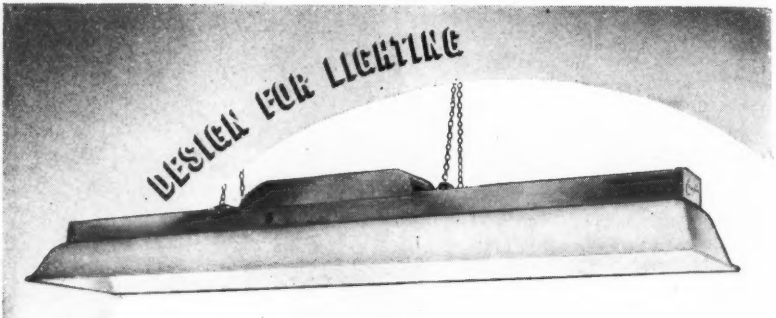
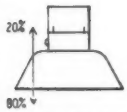
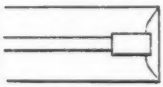
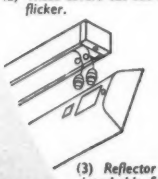




(1) *How the light is distributed.*



(2) *These covers cut out end flicker.*



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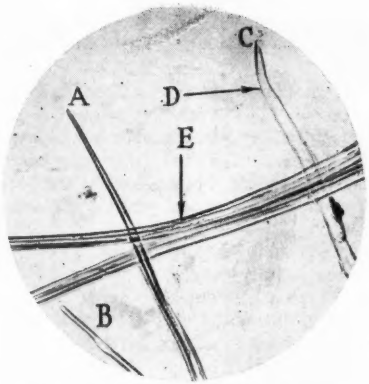


Fig. 232.—Agave cantala fibre elements: tip forms. Mag. 100 diameters.

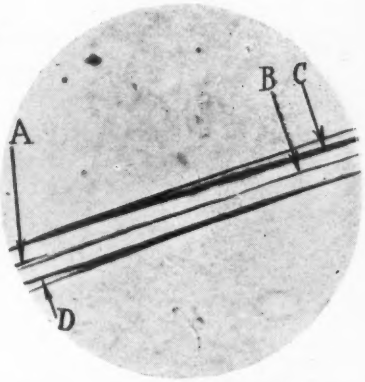


Fig. 233.—Agave cantala fibre element, showing lumen. Mag. 400 diameters.

variation of thickness in the cell wall. On the other hand, the elements shown at C and D are quite straight and regular, but in general it would appear that these elements are characteristically irregular in shape. However, this does not mean to say that all sisal fibre elements from whatever species they are obtained are similarly irregular in shape, for it must be borne in mind that in Agave cantala we are dealing with one of a dozen different species at least and therefore this characteristic need not necessarily apply in the other sisal fibres.

The irregularities present in the cell wall, along the length of the fibre, may be expected to effect the tips of the elements, which (Fig. 231) are seen to be evenly tapered; but if these are examined at closer quarters (Fig. 232, showing three element tips at a magnification of 100 diameters) it becomes apparent that they are by no means regularly tapered in all cases, for of the three shown, only that marked A may be regarded as possessing a regular taper. The element B, on the other hand, shows a bulbous swelling a little way below the tip, which is more of a spatulate shape than a tapered point. In contradistinction to the gradual taper seen at A, the tip of the element C is seen to be comparatively sharply tapered from the point of bend D, up to which point the element possesses an almost unvarying diameter, being also somewhat larger than the average in this respect.

Fig. 232 also shows to some extent the nature of the lumen in these elements, which would appear to indicate that this may be expected to be irregular in size and morphology. Thus at E is seen an element whose bore varies considerably in diameter in a very short length, and at the same time the inner surface of the lumen shows a wavy appearance, as if this surface was wrinkled, due to shrinkage.

In view of the possibility of uneven bores to these elements, let us examine some of them at closer quarters. The first thing to be noticed in a large number of the tracheids is the apparently sudden diminishing of the diameter of the lumen, such as that shown in Fig. 233, at a magnification of 400 diameters, from which it will be seen that the lumen tapers down to such an extent that it is all but obliterated in places, or so it seems. The interpretation of this image, however, is not quite so simple, for if the photograph be studied still further, other factors are brought to light which tend to negate the earlier conclusions. Thus, while it is true that the diameter of the lumen at the point A is considerably greater than at

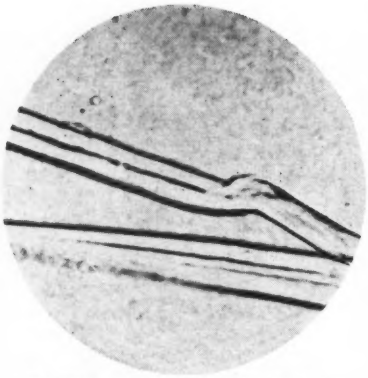


Fig. 234.—Agave cantala fibre element, showing deformation. Mag. 400 diameters.

the point B, this in itself does not justify the assumption that the lumen has suffered a diminution in diameter, because if this were so, then obviously the cell walls would be subjected to a corresponding increase in thickness, which condition is not immediately apparent.

The fibre element does, however, present a very distinct appearance of being twisted, as indicated by the edge configurations marked C and D, and from the appearance of which it is highly probable that this is the true condition. As a result of this and assuming that the lumen is flattened in cross section, this latter would produce an appearance as shown in the illustration. In actual fact, the lumen of this particular fibre is somewhat flattened in cross section, and the only conclusion we can arrive at with any degree of certainty is that the element is twisted, and at A the lumen is seen across its broadest diameter, which at B is being viewed " edge on " as it were.

To proceed with our examination of these elements, Fig. 234 is a photomicrograph of an element at a magnification of 400 diameters, and from which it is clear that we have a case of comparatively high degree of deformity, due in all probability to mechanical stress developed in the structure of the leaf during growth. It can be readily visualized in this instance how this severe bend in the tracheid could have been caused by the tips of two other elements interfering with its development.

It is interesting to speculate as to the effects, if any, which this type of distortion is liable to produce on the strength of the element if, as appears to be the case, the lumen is obliterated at the bend. It is clear that at this point the element will be solid, but whether it will be stronger here than at points where the lumen is fully developed is debatable; it could quite conceivably be stronger in tension, due to the development of somewhat greater elasticity at the bend, by virtue of this latter tending to straighten out before failing.

Reasoning along these lines, it becomes apparent that a number of points of this type of distortion along the length of any one element is a desirable condition, as being conducive to greater strength. On the other hand, it must not be forgotten that this fibre is comparatively highly lignified, hence its stiffness when compared to those materials of a less highly lignified nature. As a result of this the element under consideration tends to be somewhat more brittle, and in view of this it is possible to reason alternatively that the effect of the kind of distortion evident in this instance will, in all prob-

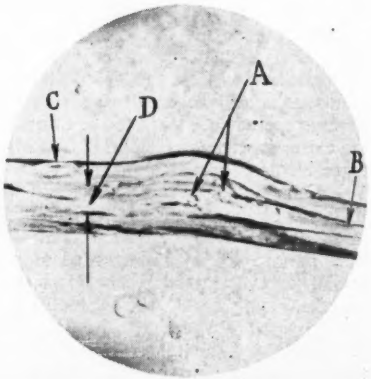
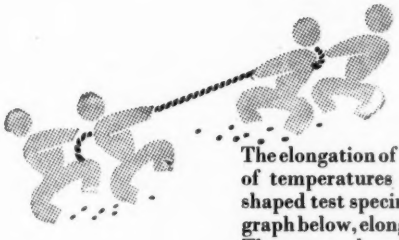


Fig. 235.—Agave cantala fibre element: enlargement of bore. Mag. 400 diameters.

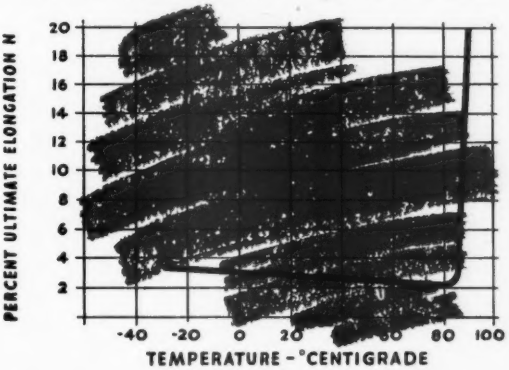
THE ELONGATION TEST

ON MONSANTO Lustron

POLYSTYRENE MOULDING CRYSTALS



The elongation of Lustron was determined over a range of temperatures using injection moulded dumb-bell shaped test specimens of $\frac{1}{4}'' \times \frac{1}{4}''$ cross section. In the graph below, elongation is plotted versus temperature. The curve shows that the toughness of injection moulded Lustron increases as temperature decreases.



Percent Ultimate Elongation vs. Temperature of Lustron

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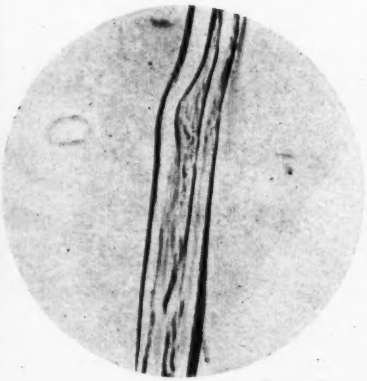

Fig. 236.—Agave cantala fibre element: distorted lumen. Mag. 400 diameters.

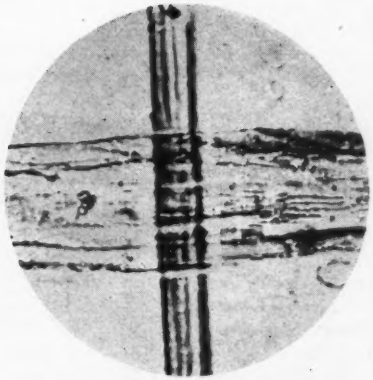

Fig. 237.— Agave cantala fibre element. Mag. 400 diameters.

ability, bring about a weakening of the element at this point. It will be seen that as the bend is solid, a tensile stress would be far more effective in bringing about a failure at this point, due to the existence of a shear component as well, apart from the absence of any beneficial effect produced by the presence of a lumen and inherent elasticity.

From the foregoing it will be appreciated that the only information which may be used with any certainty is the fact of the existence of the bend and the brittleness of the material of the fibre, and in drawing conclusions, therefore, we are left with the latter line of reasoning as being that nearest the truth and from which it may be concluded that the distortion encountered in this case is not so desirable as at first thought likely.

Let us now examine one or two of the other types of deformations to be found among the elements of Agave cantala. Whereas the abnormality just discussed may be considered as external, that shown in Fig. 235 may be classed as internal. This illustration shows an enlargement in the lumen of an element at a magnification of 400 diameters. The effect of this enlargement, which is probably due to the presence of inorganic bodies shown at A, on the lumen in general, is considerable, for it will be seen that on the side marked B the bulbous portion tapers down to a lumen of the usual size, while on side C the lumen is seen to be broad, as shown by the dimensions at D. The difference in the breadth of the lumen resulting from the cavity is considerable, in consequence of which the walls are also considerably thinner on the side where the lumen is broad. This effect is as it is seen, there being no twisting of the element in this case, and therefore we may safely conclude that the bulbous deformity is responsible for the modification in the dimensions of the lumen.

The general effect of this type of lumen, or internal deformity, on the strength of the element needs no great emphasis, as it is abundantly clear that at the seat of the abnormality and that portion of the element where the diameter of the lumen is increased, the mechanical strength of the element must be severely affected.

It is also evident in a case of internal distortion such as this that the exterior morphology of the fibre is bound to be influenced to a considerable extent, as seen in Fig. 235, but not all cases of this type of distortion have such severe effects. For example, the internal distortion shown in Fig. 236 consists of a similar bulbous swelling out of the

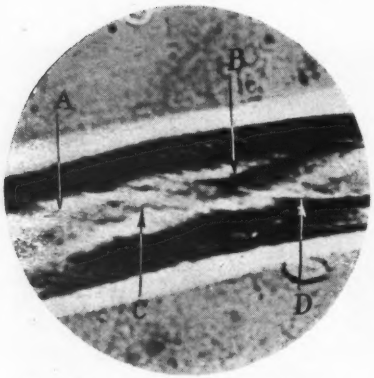

Fig. 238.—Agave cantala fibre element: bottom surface. Mag. 840 diameters.

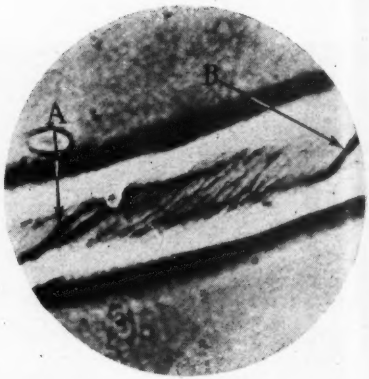

Fig. 239.—Agave cantala fibre element: top surface. Mag. 840 diameters.

lumen, but this latter has not been affected to the same extent as was seen in the previous example; in fact, the only place where the cell wall has been appreciably thinned down is at the site of the cavity, and apart from this the element remains as regular as may be expected.

As this fibre consists mainly of fibro-vascular bundles, the presence of elements other than phloem or bast tracheids is rather to be expected than otherwise, as the bundle contains large spiral vessels in addition to the phloem tissue and also elements of a somewhat larger diameter than the thick-walled units just discussed. One of these larger elements is shown in Fig. 237 at a magnification of 400 diameters. It will be seen immediately that there is a great difference in the size of the two elements, apart from which the larger one has very much thinner walls and a larger lumen. These elements are not a great deal of use as filler particles, due to their poor mechanical properties, and they may be regarded as being in the nature of an impurity, which classes them as extraneous matter.

The Agave cantala fibre elements exhibit the phenomenon of the spiral structure in the cell wall very strongly, and perhaps it is this which is responsible for its great strength; it is certainly due to this strong micellar spiral that we are able to obtain positive proof of the spiral nature of the structure. In Fig. 238 we see a portion of an element at a magnification of 840 diameters, with the micellar structure clearly visible and sloping from left to right. This photograph is taken at the lower focal plane of the element and the thickness of this latter lies above the plane photographed. It is for this reason that what appears to be a grosser structure, traversing the fibre in the opposite direction to that taken by the micelle bundles, is seen at A and B. These are actually two of the "surface pinches" previously encountered on the top surface of this element, somewhat out of focus; similar structures on the bottom surface are seen at the points C and D, which are more nearly at the focal plane, in consequence of which they are delineated more sharply. In general, the strong micellar structure is the most noteworthy point.

As expected from the assumption of the spiral micellar structure, when the upper surface of this element is viewed the structure is seen with greater clarity and to be traversing the fibre in the opposite direction to that encountered when examining the bottom surface. This is seen in Fig. 239 at the same magnification as in the previous illustration. Here

the micelle bundles, or more probably, the effects of their orientation in this manner, are very clearly shown, likewise the two surface "pinches" are easily distinguished, the spiral fibrillæ are seen to be traversing the fibre element in the opposite direction to those in the bottom surface of this unit, thus demonstrating their spiral orientation without much doubt. At the same time it will be noticed how tightly the spiral is developed, but we still appear to lack definite knowledge as to the structure of the "pinches," for from this photograph they might be gaps in the spiral as much as a bunching up of the fibrillæ at these points. In general, however, it may be concluded that the spiral fibrillar structure exists as such, but the pinches are not so readily elucidated.

Summing up the character of this fibre one may say that according to its minute structure it is possible that the material holds promise as a potential raw material from which a filler for moulding powders may be produced. The elements are such that in spite of a relatively small bore, they would in all probability be fairly easy to impregnate with resin due to the wall thickness making the cell fairly rigid and not liable to collapse upon itself, as would be the case with an element with thin or flaccid walls. The strong spiral fibrillation would seem to be a help in impregnating, particularly in cases where the aid of swelling agents may be called in, but whereas the fibre itself is very strong, this strength cannot be relied upon when it is reduced to its histological elements. There would appear to be a relatively high percentage of elements so distorted—morphologically—by growth stresses and other causes as to suffer a not inconsiderable diminution in strength. Whereas when cemented in situ, as in the whole fibre, this does not have a great influence on the overall strength, the effects of this distortion are in all probability only too apparent in the individual element divorced from its natural position in the fibre. Therefore this material would seem to have greater utility when used in the "cut up" condition.

(To be continued.)

Chlorine Determination in Polymeric Materials

THERE is a considerable need for a quick and accurate method for determining chlorine in polyvinyl chloride compositions; all the methods published so far are either long-winded or require expensive and fragile equipment (quartz glass).

A paper on this subject by Dr. Ing. K. Stoeckhert (Hanover) has recently been published in "Kunststoffe" (1947/37/53).

The author reviews the most commonly used methods (by Carius, Parr, Baubigny and Chavanne, Grote and Krekeler, Hofmeier and Schröder), all of which have some of the disadvantages mentioned above. A method first published by Pringsheim* for the determination of chlorine in organic compounds appeared to be more promising. By varying the composition of the fusion mixture and by studying the most suitable heating cycle, the author discovered that a mixture containing three parts Na_2O_2 and one part Na_2CO_3 could be mixed readily with polymer powder; furthermore, the reaction proceeded smoothly and without splutter, but at a speed which was still satisfactory. A mixture containing two parts of Na_2CO_3 to three parts Na_2O_2 reacts very slowly. The 3:1 mixture used in the proportions 20:1 (fusion mixture to polymer) can be ignited with a red-hot steel wire. Good results are obtained after fusing for 3 to 4 minutes.

The method employed is as follows:—Mix approximately 0.2 g. of polyvinyl chloride with approximately 4 g. of a mixture consisting of one part Na_2CO_3 (water free) and three parts Na_2O_2 in a steel crucible. Cover the crucible with a lid which has a small hole through which the mixture can be ignited by means of a red-hot steel wire. Heat for another two minutes after termination of the reaction until the contents of the crucible are properly fused. Cool and leach the melt with warm water, transfer the solution to a covered beaker and boil until the deve-

* H. Pringsheim, Berichte der Deutschen chem. gesellschaft, 1903/36/4244, 1904/37/2155, 1905/38/2459, 1908/41/4267. J. Amer. Chem. Soc., 1904/31/386. Angew. chemie, 1904/17/1454.

lopment of oxygen stops. (Iron oxide scale becomes detached from the walls of the crucible during cooling; an excess of iron oxide may interfere with the further treatment of the solution.)

Table 1.

Type of polymer	Chlorine per cent.	
	present	found (average value)
Polyvinyl chloride ..	55.5 ± 1.0	54.1
Vinyl chloride copolymer	46.5 ± 1.0	46.7
Vinyl chloride copolymer	28.5 ± 1.0	29.7
Polyvinyl chloride ..	55.5 ± 0.5	54.9
Vinyl chloride copolymer	34.0 ± 0.5	34.0

Add 3 ml. of saturated sodium bisulphite solution and sufficient H_2SO_4 until all the iron oxide is dissolved, boil until all SO_2 is driven off and acidify with HNO_3. Determine the chlorine in the solution according to any of the known methods (gravimetric or titrimetric) with silver nitrate. Results obtained are given in Table 1.

Raw material position of German plastics industry is reviewed by G. Matulat in "Kunststoffe," 1947/May/93. The author admits that an accurate and detailed survey is not possible, so long as the present zonal divisions exist and the supply of the basic raw material—coal—is not settled. The article deals with plastics derived from natural products, condensation and polymerization products, as well as polycondensation products.

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It is possible for a moulding to be produced larger than the mould in which it is made; this may happen when abnormally high pressure is used in a positive mould or in a transfer mould in which feeds, gates and mould clamping pressure are adequate.

Fig. 1 shows a compression mould for a cylindrical moulding 2¾ in. long, 1 in. dia. and 3/32 in. thick. The slightest lack of care in evenly loading the cavities of the multi-impression mould resulted in mouldings varying in length up to as much as 3/32 in. oversize through overcompression. The expansion of the moulding in length and also in diameter at the top after the punch was extracted is shown in Fig. 2, this being due to a moulding pressure of 6 tons per sq. in. having been used in a mould where a close fitting cavity, so designed to ensure concentricity, prevented escape of excess material.

Reduction of the pressure alone resulted in thick flash on some mouldings and a number of short mouldings in the same lift. The solution lay in increasing the clearance in the cavity and providing spue grooves. This not only overcame the trouble but permitted a reduction in moulding pressure also.

In a transfer mould in which the gate and feed had in the first place been designed deliberately somewhat undersize, "shorts" were a regular feature of production notwithstanding an increase in transfer pressure. In this case an alteration to the mould to provide larger feeds and gate overcame the moulding trouble but caused overcompression and oversize mouldings until the pressure was reduced from approximately 17 tons to 10 tons per sq. in.

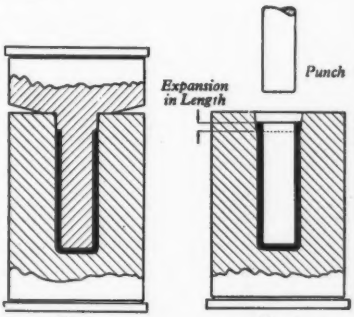

Fig. 1

Fig. 2

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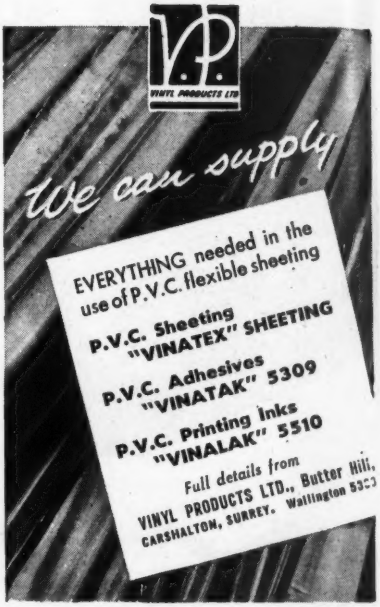
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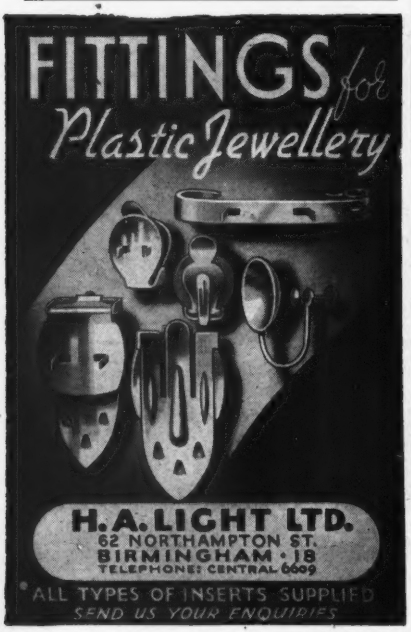

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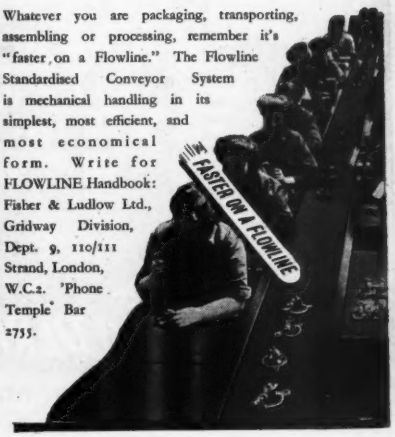

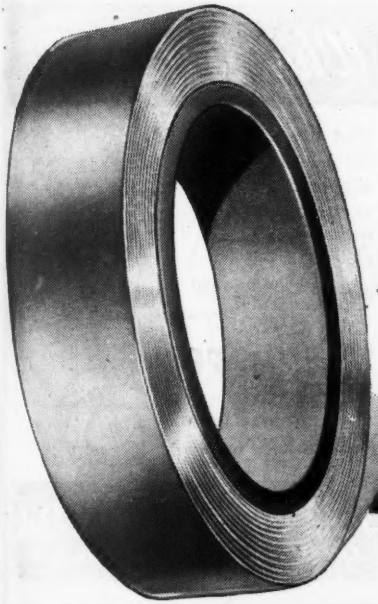

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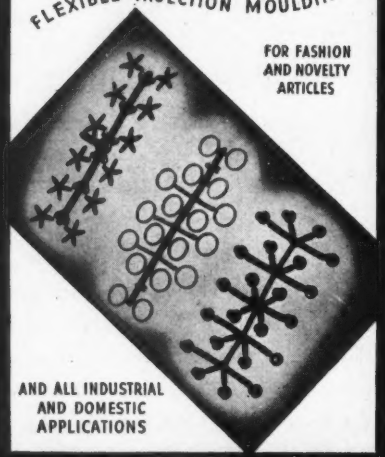

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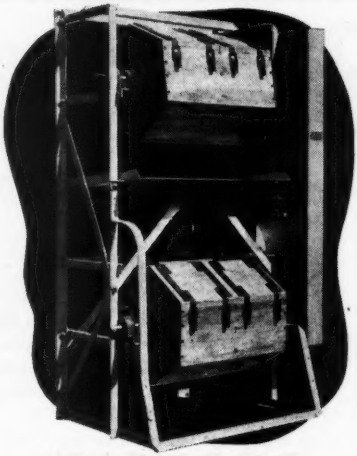

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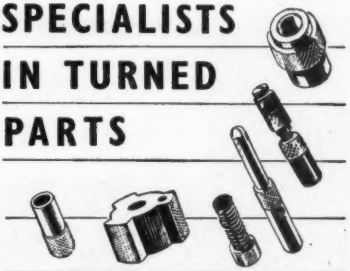

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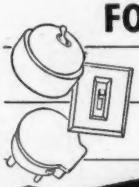

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Former "Airfix" agent, free on October 31, desires to represent for home trade and export, serious, reliable, progressive manufacturers of plastic goods. Box 1236, care of "Plastics." 126-43

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Agencies wanted for the sale of plastic and Perspex articles. Offices operating from all large cities. Send particulars for cash on delivery to N. Gerver, Plastic Sales Dept , 2-10 Mare Street, Hackney, London, E.8. Phone, Amherst 5805 (five lines). 130-25

Leading maker of every type of industrial dielectric radio frequency heating equipment requires agents in the following areas: Tyne Valley, South Wales, West Country, East Anglia. Agents are also required in the following countries: Belgium, France, Italy, Egypt, South American and South African countries, also Australia and New Zealand. Write, Box 1112, care of "Plastics." 126-19

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Experienced plastic engineers invite inquiries for the design of your moulding requirements. Drawings supplied in strictest confidence. Tooling capacity available. Inventors' ideas developed. Apply, Technical Manager, Kays Industries, Ltd., 10 Bakers Lane, Ealing, W.5. Phone, Ealing 7162. 126-x2030

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Stainless Steel Enclosed VACUUM REACTION KETTLES or STILLS, approx. 1 ft. 10 ins. by 2 ft. 4 ins. deep, bolted top cover with manhole and glanded agitator entry, stainless steel agitator; mild steel outer jacket 50 lb. per square inch steam pressure, crown wheel and pinion fitted to agitator shaft; drive from fast and loose pulleys, bottom outlet, suitable for small-scale synthetic resin manufacture.
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Two sets hydraulic pumps, by Fielding and Platt, nearly new, horizontal, approximately 200 gallons per minute at 1,750 lb. per sq. in., reduction gear 730 to 120, motor 290 h.p., 400/3/50. Thompson and Son (Millwall). Ltd., Cuba Street, London, E.14. zzz-448

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MODERN DESIGN HORIZONTAL HYDRAULIC PUMPS.
Details as follows:

Two modern design Unused Horizontal Three-throw Enclosed-type Hydraulic Pumps, model 38/173, by Davy and United Engineering Co., Sheffield, each having rams 3¼ ins. diameter by 12 ins. stroke, approximate capacity each 160 gallons per minute; crankshaft speed 150 r.p.m., pressure 2,240 lb. per sq. in., forced-feed lubrication, four-bearing-type crankshaft, arranged for motor drive through totally enclosed gearbox with double-helical teeth, ratio 740/150 r.p.m. by Turbine Gears, Ltd.; also Wellman Bibby couplings (no motor included). H.P. to drive, 275; 740 r.p.m.

The pumps are suitable for pressures up to 3,000 lb. per sq. in.

Two practically new modern design Horizontal Three-throw Enclosed-type Hydraulic Pumps, model L.10/U.31, by Fielding and Platt, Ltd., each having rams 4¼ ins. diameter by 10 ins. stroke, approximate capacity each 180 gallons per minute; crankshaft speed 120 r.p.m., pressure 1,750 lb. per sq. in., forced-feed lubrication, four-bearing-type crankshaft; each driven through totally enclosed gearbox with double-helical teeth, ratio 730/120, by Urquhart Lindsay and Robertson, by 290 h.p. slip-ring motor by Mather and Platt, Ltd., 400 volts, three-phase, 50 cycles, 730 r.p.m., with hand-operated starter.

The pumps are suitable for pressures up to 2,240 lb. per sq. in.

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SOUTH WALES WORKS: NEWPORT, MON.
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Injection press for sale with Bradley and Turton pump, designed for alkathene mouldings up to 10 oz. capacity; the press is fully automatic with subsidiary ram for mould closing. Box 1121, care of "Plastics." 126-x1581

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Moulds wanted (redundant) for 20-ton compression press and ⅝ oz. injection machine. Details and prices to Box 1238, care of "Plastics." 126-8

Wanted, laboratory autoclave, capacity of the order of 1 gallon, made of alkali-resisting material, sufficient to withstand pressures up to 10 atmospheres. Box 1239, care of "Plastics." 126-9

Wanted urgently, two Bridge Banbury mixers, sizes 1 and 3A. R. Klinger, Ltd., Sidcup. 126-13

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Work wanted, tool room available for all sorts of press tools. Press work, assembling, spraying and all sorts of engineering to your design. Universal Components, Ltd., 19 Sunderland Terrace, W.2. Bay 6776. 131-392

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We invite inquiries from buyers at home and abroad for highly distinctive articles to their own design. Our products are noted for their originality and superior finish.

Our excellent mould-making facilities, backed by many years of experience in this field, is well to the forefront among the leaders, and this enables us to give a service second to none.

ORNIA, LTD.,
Manufacturers of Specialities from Thermo-plastics.
50 STATION ROAD, LONDON, N.W.10.

Phone, Elgar 5160. Cables, "Ornia, Harles, London." 126-23

Injection moulding capacity available on 3-oz. injection moulding machine for short and long runs. Box 9035, care of "Plastics." zzz-438

Embossing and reproducing of wording, designs and all matter carried out on plastics, leathers, showcards and all materials. L.I.S.T., Ltd., Fernhead Works, Fernhead Road, W.9. 126-3006

Injection moulding capacity available with manufacturers specializing Polythene products. Assistance offered with tool design and manufacture in own tool room. Box AC22942, Samson Clarks, 57-61 Mortimer Street, W.1. 126-3245

Plastic products trade-marked, branded, ornamented, etc., by stamping in gold, silver, pigments; clocks, instruments, Perspex display units. The Superb Stamping Co., 84 Highbury Park, London, N.4. Can 1915. 127-x137

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Capacity for design-manufacture of press tools, moulds, jigs, fixtures, repetition turning, springs and presswork. The Super Ease Tool Co., Highfield Works, Oakley Road, Redditch. 126-3

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Repetition in Ebonite, Erinoid, etc. Capstan lathe work. Mansell, Temple Street, Rugby. 137-3687

Chromium plating. Capacity now available for polishing and plating. Good delivery and competitive prices. Consult us on all your plating troubles. W. and D. Electrical Co., 95 Park Road North, W.3. Phone, Aco 5930. 126-31

Langley (London), Ltd., offer substantial and regular supplies of laminated plastic S.R.V.P tubes in round and rectangular sections. Some additional capacity available for processed tubes, but principally for plain tubes in lengths up to 40 ins. Inquiries are invited. Langley (London), Ltd., 161 Borough High Street, London, S.E.1. 126-33

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Injection moulding capacity available on 3-oz. machine for short and long runs with customers own moulds. Box 820, care of "Plastics." 126-x681

Production Capacity Available and Wanted (contd.)

Silk screen printing on plastics, etc., for publicity and display. Inquiries invited for designs. The Crescent Studies, Chapel-en-le-Frith, Stockport. 126-x1580

Immediate moulding press capacity available for long runs in black powder. Customers' tools used if available, or tool produced quickly by us. Lionel Service (Plastics), Crew's Hole Road, St. George, Bristol, 5. 126-x680

Cast phenolics. We have immediate capacity available for the production of cast resin articles in all colours. From mould-making to completed assembly. Box 1266, care of "Plastics." 126-x1917

Capacity available for alkathene mouldings up to 8 ozs. Own toolroom. Box 1122, care of "Plastics." 126-x1581

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Offer specially:
1/16-in., ⅛-in. and ¼-in. coloured.
Write for stock list and particulars to:—
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120 MOORGATE,
LONDON, E.C.2. zzz-446

Ebonite and bakelite always in stock. Phone, Archway 3654. A. E. Goodeve, Ltd., 188a Seven Sisters Road, London, N.7. zzz-445

For sale, P.V.C. scrap. Offers invited. Box 8494, care of "Plastics." zzz-426

Cellulose acetate scrap urgently required; best prices paid. Write Cuprex, Ltd., Finsbury Pavement House, 120 Moorgate, London, E.C.2. Phone, Metro. 9641-5. zzz-424

Wanted, "Perspex" sheeting, all thickness, coloured and clear, in any sizes, multiple of six over 12 by 12; coloured and clear "Perspex" off-cuts; coloured 10-thou. cellulose acetate, suitable for lamp-shade making; large or small quantities purchased. Box 580, care of "Plastics." 126-3040

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Perspex and Crinothene, official I.C.I. stockists for North-West area, invite inquiries for flat sheet Perspex, clear and coloured, from 1/16-in. to ½-in. thickness; also official I.C.I. stockists of Crinothene. Plastics (Manchester), Ltd., 11 Whitworth Street, Manchester, 1. Phones, Central 0272 and 1725. zzz-447

Black Cellulose Acetate 52-in. by 24-in. by .06-in. thick. 2,000 sheets available semi-polished, first-class condition. Specification DTD.315. Immediate delivery. Box PP12356, Samson Clarks, 57-61 Mortimer Street, W.1. 126-3247

Highest prices paid for P.V.C. sheeting. Samples to Dept. A.S.T., Newton Home Products Co., Ltd., 93 Goldsmith Street, Nottingham. 127-x172

Perspex acrylic sheet. Stockists offer good range in clear and coloured. Stock lists available. J. H. Berry (Plastics), Portland Works, Annesley Woodhouse, Notts. East Kirkby 2151. 127-2195

Metal powders and oxides. Quotations and samples on application. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-410

We are now able to supply an adhesive suitable for cementing the Perspex which we supply. Inquiries to Cuprex, Ltd., Finsbury Pavement House, 120 Moorgate, London, E.C.2. zzz-429

For sale, 15 tons P.V.C. black compound (recovered); samples available. Write to Cuprex, Ltd., Finsbury Pavement House, 120 Moorgate, London, E.C.2. zzz-428

Wanted, plastic waste and plastic piece goods. Send particulars, stating quantity and price. Box 6695, care of "Plastics." zzz-400

Perspex off-cuts, clear and coloured, cut to required size, lactoid rods and all forms of scrap plastic material; immediate delivery. Write, Plastic Department, J. E. Hoare, Byton Chambers, Amen Corner, S.W.17. zzz-399

Perspex and Acetate supplied, one or more sheets. Box PP13468, Samson Clarks, 57-61 Mortimer Street, W.1. 126-42

For Sale. Cell. Acetate foils, thickness .007-in., in rolls, width 22-in. cca 20 tons, in 10 opaque colours, polished on both sides. Inquiries, Box 1310, care of "Plastics." 126-40

Regular supplies of imported phenolic and urea powders, polystyrene and cellulose acetate injection powders. Inquiries, Box 1211 care of "Plastics." zzz-454

Raw Material Available and Wanted (contd.)

S. R. F. FREED, LTD.,
THE STOCKISTS OF SHEETS, RODS, TUBES, OFF-CUTS AND SCRAP.
OFFER OTHER LINES WHICH CAN BE USED IN COMBINATION WITH PLASTICS, UTILIZING ANIMAL AND VEGETABLE PRODUCTS.

Such as tortoiseshell, horn, cleaned and prepared cattle bones for industrial purposes, vegetable ivory nuts, porcupine quills, goose and duck feathers, and barrels, etc.

S. R. F. FREED, LTD.,
27b HIGH STREET, SOUTH NORWOOD, S.E.25.
Phones, Livingstone 4042; Sanderstead 2056.
126-402

D. H. Ridout and Son, Ltd., Reg. Office 12 Stedman Road, Southbourne, Bournemouth. Phone, S'bourne 505 offer for immediate delivery.
650 sheets unpolished Perspex, 39-in. by 30-in. by 5/16-in. at 4s. 9d. lb.
400 sheets clear paper-covered polished Perspex 48-in. by 36-in. by 5/32-in. at 5s. 6d. sq. ft. Special terms for quantities.
17 cwt. unsorted Perspex scrap, good proportion large pieces, 1s. 3d. lb. in cwt. lots. Cash with order.
2 cwt. Tangerine Acetate sheets 48-in. by 20-in. by 1/16-in., 30s. per sheet.
2,000 ft. 1¼-in. ribbed plastic belting, dark green, 3d. ft.
3,000 ft., ditto, London Tan, 3d. ft.
4,000 sq. yds. rubber flooring tiles, 12-in. by 12-in. and 24-in. by 24-in., various colours, 25s. sq. yd.
680 plastic sheets, 8-ft. by 4-ft. by ⅛-in. and 1/16-in., suitable for caravan or building partitions, from 45s. sheet.
10 cwt. transparent Acetate sheeting, .007-in. thick, 3s. 6d. lb.
20 tons Coir mattress fibre, from 4d. lb.
4 tons art silk waste stuffing material, 7d. lb.
5,000 pairs canvas mittens, ex-Government stock, quick-release wrist fasteners, suitable gardening, heavy work, etc. 54s. per gross pairs.
Plastic door furniture, complete with locks, at keen prices. 126-39

Plastic strips, 1 in. and 1⅜ ins., various colours in stock. Holden and Hitchon, Ltd., 175 Piccadilly, London, W.1. Phone, Regent 4888. 126-35

Scrap. Why not let a well-established firm quote you for cellulose acetate, polystyrene, P.V.C. cuttings and other thermoplastic off-cuts and scrap? Having best use for these materials, highest prices can be paid. Quotations on receipt of representative samples to M. H. Grist (Plastics), Ltd., 82-84 Brighton Road, Surbiton, Surrey. Phone, Elmbridge 4214. zzz-457

Wanted, plastic sheeting in all thicknesses from 1-16-in. to 1-in. Can place large orders for home and export markets. Please submit samples and prices to N. Gerver, 2-10 Mare Street, Hackney, London, E.8. zzz-456

Regular supplies of imported celluloid and cellulose acetate sheets, tubes and rods. Inquiries, Box 1212, care of "Plastics." zzz-455

Paraformaldehyde, three tons available, 1s. 2d. per pound. Box 1237, care of "Plastics." 128-3689

Celluloid, 30 sheets, 100/1,000 thick, surface slightly scratched, price 3s. 6d. per pound to clear. Also White ivorine, approximately 1,800 pieces, 18 ins. by 12 ins. by 60/1,000 thick (900 clean, 900 printed on one side, but easily removed); price 1s. 6d. each or 2s. per pound to clear the lot. N.E.W., Box 1210, care of "Plastics." 126-27

For immediate disposal, 800 lb. natural P.V.C. sheet, .012 in. by 4½ ins. wide; 200 lb. P.V.C. tube, 25 mm., seamless. Box 1111, care of "Plastics." 126-18

Approximately 12,000 lb. of P.V.C. chips and slabs, various colours, extruding quality, for disposal. For particulars write Box B.373, care of Jacksons, 16 Grace-church Street, E.C.3. 126-16

Perspex. Ashdowns, Ltd., Eccleston Works, St. Helens, have quantities of clear and coloured for disposal. 126-14

Perspex (Acrylic sheets). Several thousand feet of Perspex for sale, paper covered, up to ¾ in. thick, clear and coloured. Seen London area. Box 1240, care of "Plastics." 126-10

For sale constantly, cut-offs of ⅛ and 1-16-in. natural Holoplast, from 1s. per pound, according to size of pieces. Larks Spraying Process, Monument Hill, Weybridge. 126-4

Moulding powders. If you have any redundant stocks for disposal contact us and also give us your inquiries if you are in need of supplies of other powders. Box 9756, care of "Plastics." 128-3736

Raw Material Available and Wanted (contd.)

Plastic boards, 1-16-in., specially treated, highest artistic finish; suitable for panelling, furniture, bath, splash-backs, etc.; plain colours or marble effect, and wood (oak, mahogany, walnut, etc.), sheets 8 by 4 cut to requirements. Prompt deliveries. Larks Spraying Process, Monument Hill, Weybridge. 126-5

Perspex for sale, new sheets, offcuts, large and small scrap, powders; clear and colours. Box 9024, care of "Plastics." 128-3737

Barrell polishing compounds, a small quantity at cut price from Opticrafts, Ltd., Berrylands Road, Surbiton. Elmbridge 5371. 126-6

P.V.C. strippings from cables, thoroughly cleaned, black, brown, red, yellow, blue, etc. Segregated. Large quantities. 1s. 3d. lb.
John Walton and Co., (Castleside), Ltd., Metalex Works, Gt. Cambridge Road, Enfield. Phone, Enfield 3425. zzz-458

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 50, inclusive, or a woman between the ages of 18 and 40, inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

Technician required for development work on moulded track carbon potentiometers. Applicants must have had several years' experience in the plastics moulding industry, and should possess a good general technical background, preferably with a knowledge of electronics. Post is in the Swindon area and carries good prospects of advancement. Age 25 to 35. Salary according to experience, in region of £500. Please write, giving full particulars to Box 503, care of "Plastics." 126-3002

REPRESENTATIVES REQUIRED.

A well-known London company, fabricating and machining plastic materials, is considering engaging additional outside Sales Staff for the following areas:—

1. SOUTH-EASTERN COUNTIES.
2. SOUTH-WESTERN COUNTIES.
3. MIDLANDS.
4. LANCASHIRE.
5. WALES.
6. SCOTLAND.

Applicants should have a knowledge of engineering and the application of Laminated materials. Salary, expenses and commission. Write in first instance, giving full details, to Box 1109, care of "Plastics." 126-44

Diesinker Engraver required by firm engaged on plastic mould work in Essex; person with experience is offered a permanent progressive and well-paid position. Send fullest details to Box 508, care of "Plastics." 127-3003

Toolmaker required. Experience on plastic mould work essential. Person with experience is offered a permanent, progressive and well-paid position. Send fullest details "Seaforth," Watchett Works, Oakhurst Road, Southend. 127-3045

Chemist required at once to take charge of laboratory in laminated and moulded plastics factory; degree standard or equivalent with experience in plastics industry preferable. Full particulars and experience to Personnel Manager, Bushing Co., Ltd., South Drive, Hebburn-on-Tyne. 126-x1982

Two physical chemists required by plastics manufacturers (South England). Good degrees essential, Ph.D. standard preferred for one position. Modern laboratories, interesting work, five-day week; attractive salaries, plus bonus. Write in strict confidence, giving usual details. Box 1311, care of "Plastics." 127-3733

Required by electrical equipment manufacturers, man, experienced in the working of Perspex, to supervize the establishment of a department and carry out experimental work. Box 1309, care of "Plastics." 126-41

Works manager. Applications invited for appointment to firm in South of England producing plastic materials. Chemical or chemical engineering qualifications desirable; must have comprehensive knowledge of modern production methods and successful experience of staff and labour control. No one considered over 40 years of age. Initial contract three years. £1,300-£1,400-£1,500 per annum, plus bonus, also liberal contributory pension scheme. Full but concise details of experience must accompany applications, which will be treated in strict confidence. Box AC23823, Samson Clarks, 57-61 Mortimer Street, W.1. 126-38

Wanted, first-class press and mould tool maker, good opportunity and remuneration. Apply Peter Kenton and Co., Ltd., 47 Whadcoat Street, London, N.4. 127-3688

Situations Vacant (contd.)

B.X. Plastics, Ltd., require development chemist at their Dundee factory for work on p.v.c. and cellulose acetate. Previous industrial or research experience desirable. Excellent prospects and conditions in newly established factory. Salary £500-£550 per annum. All applications to Personnel Manager, King's Cross Road, Dundee. 126-32

Large plastic moulding company has vacancy for a technical manager to take full responsibility for all technical matters relating to moulding and finishing departments, and for the estimating, design and manufacture of moulds, jigs and fixtures. Applicant must have had extensive practical experience in all sections and must have held executive positions for at least five years. Excellent permanent position with good salary. State age and give full particulars of experience to Box 1114, care of "Plastics." 126-20

Works manager, experienced in calendering and compounding of plastic materials (P.V.C., etc.), to direct and supervise production. Works N.E. Coast. Long-term agreement and good salary. Applications with full particulars of experience, which will be treated in strict confidence. Box 1329, care of "Plastics." 128-3738

Immediately, experienced operators for calendering, compounding, embossing and coating of plastics for N.E. Coast works. Permanent employment and good wages to experienced men. Applications to Box 1330, care of "Plastics." 128-3739

Plastics engineer required to take complete charge of the Plastics Department of The English Electric Co. situated at its Bradford Works. This department supplies plastic components for the many products of the various works of the company and is expanding rapidly. The position offers excellent opportunities to a young man with the right experience, qualifications and personality. Applicants should have had experience of production methods and of handling personnel, and should be fully conversant with all types of plastic moulding. This position is excepted from the provisions of the Control of Engagement Order, 1947, and those interested should write for an application form direct to the Labour Superintendent, English Electric Co., Ltd., Bradford. 126-29

Wanted, foreman and mould maker for production of injection and compression moulds, who is also able to take over some office duties and design his own tools if necessary, for a progressive young firm with modern toolroom. Knowledge of injection moulding preferred, but not essential. Only top men need apply. Box 1116, care of "Plastics." 126-22

Large plastics manufacturers require services of junior representative for the Midland area, operating from Birmingham. Age 22-28. Education qualifications, graduate or Inter. B.Sc. or matriculation. Knowledge of plastics an advantage. Write, giving full details, to Box 1235, care of "Plastics." 126-7

Representatives with chemical and engineering background required by well-established plastics manufacturer, N.E. London area, experience not essential as training period necessary. Full particulars to Box 1351, care of "Plastics." 128-3788

SITUATIONS WANTED

Technical executive (30), desires change; unqualified, but university education to degree standard, chemistry and mathematics; accustomed to high-level contacts, both personal and by correspondence; excellent English in letters, reports, etc.; eight years' laboratory, works and administrative experience thermoplastics (mainly acrylics), but would consider any field and any post offering responsibility and scope for initiative; wide interests include abstracting and cataloguing patents and other technical literature; now living Middlesex, but any locality considered, home or abroad; salary required £650, with prospects. Box 1201, care of "Plastics." 126-x1820

Chemist, plastics technologist, with experience in production of thermoplastic materials, film casting and chemical engineering, seeks post in factory or laboratory. London area. Box 1200, care of "Plastics." 126-x1821

Production controller, Grad. I.I.A. (31), with practical engineering background, seeks progressive appointment. Box 1221, care of "Plastics." 126-x1859

TIME RECORDERS

Factory time recorders. Service rental. Phone, Hop 2239. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 137-3686

MISCELLANEOUS

Extend Your Trade.
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Trade Mark Protection Society,
12 Church Street, Liverpool. 130-9745

Miscellaneous (contd.)

We supply within 24 hours Golderstat Photocopies, the inexpensive reproduction of documents, illustrations, photographs, etc. Golderstat, 54 Golders Gardens, London, N.W.11. Spe 5643. 126-659

Engraved name plates, scales, dials, etc., supplied. Tickets and Co., Box 2, Silver Street, Leicester. 129-9541

Huts. Nissen type, 36 ft. by 16 ft. and other sizes; also other industrial buildings suitable for workshops, canteens, site offices, clubs, etc. No licence required. Write, phone or call (open Saturday afternoons). J. Thorn and Sons, Ltd., Box 138, Brampton Road, Bexleyheath, Kent. Phone, Bexleyheath 305. zzz-430

Photography by Behr will show your product at its best. Ask for illustrated list. 44 Temple Fortune Lane, London, N.W.11. Speedwell 4298. zzz-436

Monomarks. Permanent London address. Letters redirected, 5s. p.a. Write, Monomarks, BCM/MONO76, W.C.1. 128-2192

W. Page and Sons, Ltd.
Cartons, wooden cases, tea chests and other packing materials.
May we remind our many friends that the supply position with regard to packing materials of all kinds is a bad one, and is not likely to improve. By virtue of our progressive buying policy we are still able to offer large stocks of new and once-used cartons, tea chests and other packing materials, and invite your inquiries. New corrugated cartons made to your own specification from off-cuts, for which no Board licence is required. Your inquiries will receive our best attention.
The price of tea chests has now been advanced owing to higher cost of collection from the blenders. Large tea chests, 24 by 19 by 19, at 6s. 6d. each, all in perfect condition; small tea chests, 15½ by 15½ by 19½ and 18½ by 16½, at 5s. 6d. each.
Export cases, 18 by 17 by 16, with ⅜-in. ends and ⅝-in. sides, bottoms and lids, at 6s. each.
Packing service.
Will you kindly note that as from October 18 we shall be opening our packing warehouse, which is equipped to deal with packing of all kinds, both for the home and export markets. We will receive the goods, pack them in cartons or wooden cases to your specification, and will despatch them in perfect condition to your customers. If this service appeals, we would be pleased to send our representative to discuss the details. We are in a position to supply materials and our experience in this field will save you money on packing costs and will certainly save space in your factory that could be turned over to increased production.
Write or phone. W. Page and Sons, Ltd., 34 Langside Crescent, Southgate, London, N.14. Phone, Palmers Green 5087 and 9916. zzz-452

Manufacturers of greeting cards require additional competitive lines for their travellers calling on wholesalers throughout England and Wales. Box 706, care of "Plastics." 127-3246

Perspex sheeting, display signs, plastic moulded products supplied by Kays Industries, Ltd., 10 Bakers Lane, Ealing, W.5. Ideal export lines. 126-x2030

Let me translate your export correspondence, commercial or technical, all important languages. P. W. Berlin, 45 Parliament Hill, N.W.3. Hampstead 7824. 126-x1860

Plastic toys. Large range, hard, durable, hand-painted toy soldiers—Jocks, guards, buglers, sailors, knights, etc. Prices according to detail; large or small orders accepted, loose or boxed in dozens and half-dozens. Export orders required. Plastoy Products, 41 Marchmont Street, Holborn, W.C.1. 126-x1470

Calendars, 21-piece perpetual-figure sets, celluloid, for all ornamental calendars.
Tickets and Co., Silver Street, Leicester. 129-3734

For sale, containers for all types of materials, large drums to small tins, tubes and bottles. We welcome all inquiries to Box 1199, care of "Plastics." 126-x1822

Available, 50,000 strong waxed cylinders, slip lid, clear inside, 4¼ ins. diameter by 20¾ ins. tall, weight 2 lb., offered cheaply for prompt clearance ex London. Box 1223, The Container Reclamation Co., Ltd., 82-94 Seymour Place, London, W.1. 126-30

50,000 to 70,000 sets of bakelite parts, comprising cover and flanged base:—
Cover: Length, 1½ ins.; outside diameter, ¾ in.; inside diameter, 21-32 ins.; depth, 1 15/32 ins.
Flanged base: Length, 3/16 in.; flange length, ⅛ in.; flange diameter, 1 in.; second diameter, ⅞ in.; recess to take cover sunk ¼ in. Box 1115, care of "Plastics." 126-21

Quantities of clear, semi-matt, eggshell and full gloss lacquers for immediate disposal at reasonable prices. Write, Crosby and Co., Farnham, Surrey. 126-45

Surplus Casein rods, red, turquoise, 6-6, 3 mm., about 95 lb. available. Offers. Box 1343, care of "Plastics." 126-x2210

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